SPECIFICATIONS

FOR

WASHINGTON COUNTY SERVICE AUTHORITY

MIDDLE FORK WTP UPGRADE TO 12 MGD

COMMONWEALTH OF VIRGINIA
8·10·10
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AUGUST 2010

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WASHINGTON COUNTY SERVICE AUTHORITY

MIDDLE FORK WTP UPGRADE TO 12 MGD

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APPENDIX A - GEOTECHNICAL STUDY

Advertisement for Bids

Washington County Service Authority

Owner

25122 Regal Drive
Abingdon, Virginia 24211

Address

Separate sealed Bids for the construction of three projects:

Washington County Service Authority - Middle Fork Water Treatment Plant Upgrade to 12 MGD. The project upgrades the WTP from a treatment capacity of 6.6 MGD to 12 MGD. The work consists of a new flocculation basin, energy recovery building (bid-alternate), intermediate booster pump station, 3 adsorption clarifiers, 4 new dual media filters, refurbishment of 3 dual media filters, clearwell addition, new chemical feed facilities, administration facility upgrades, and all associated improvements.

Washington County Service Authority - South Fork Intake. The project includes a new raw water intake and pumping station with a capacity of 12 MGD. The work consists of screen intakes, vertical turbine pumps, emergency generator (bid-alternate), and all associated associated improvements.
improvementsassociated improvements.

Washington County Service Authority - Raw Water Transmission Pipe Line. The project includes 28,800 ft of 18" PVC pipeline and appurtenances.

Bids will be received by
Washington County Service Authority

at the office of
Washington County Service Authority, 25122 Regal Drive, Abingdon, VA 24211

until 2:00 p.m. (Local Time) on **September 14, 2010**, and then at said office publicly opened and read aloud.

The Contract Documents may be examined at the following locations:
Washington County Service Authority, 25122 Regal Drive, Abingdon, VA 24211
The Lane Group, 124 Depot Avenue, Chilhowie, VA 24319
Olver Incorporated, 1116 South Main Street, Blacksburg, VA 24060
F.W. Dodge Offices – Richmond, Virginia
AGC Plan Rooms – Blountville, TN; Greensboro, Raleigh, and Ashville, North Carolina
Valley Construction News – Roanoke, Virginia
Builder's Exchange – Knoxville, Tennessee and Richmond, Virginia

Copies of the Contract Documents may be obtained at the Issuing Office, The Lane Group, (276) 646-2520, located at 124 Depot Avenue, P.O. Box 1340, Chilhowie, Virginia 24319 upon payment of $350 for each set of the Middle Fork Water Treatment Plant Upgrade to 12 MGD Project; $200 for each set of the South Fork Intake Project; and $150 for the Raw Water Transmission Pipe Line Project. No refund will be issued.

Bidders are required under Section 54.1-1112 of the Code of Virginia to show evidence of Certificate of Registration before their Bid may be received and considered.

No bid may be withdrawn for a period of 60 days after the date of bid opening except in accordance with Section 2.2-4330 of The Code of Virginia, as amended. The OWNER, as Contracting Owner, has seleeted the first procedure for the withdrawal of bids as set forth in the section of the Code as cited above.

In accordance with the Code of Virginia, Article 22-4343.1, the Washington County Service Authority does not discriminate against religious organizations or on any other basis prohibited by state or federal law.

This contract is expected to be funded in whole or in part using funds from the American Recovery and Reinvestment Act (ARRA). Section 1605 of the ARRA prohibits the use of these funds unless all iron, steel, and manufactured goods are produced in the United States. All iron and steel manufacturing processes must take place in the United States, except for metallurgical processes involving refinement of steel additives. There is no requirement for the origin of components and subcomponents of manufactured goods. Products listed 48 CFR 25.104(a) have been determined to be unavailable in the United States and if required for the project may be purchased from foreign sources. No unauthorized use of foreign iron, steel, and/or manufactured goods will be allowed on this project.

A non-mandatory Pre-Bid Meeting on the South Fork Intake and Raw Water Transmission Pipe Line Projects will be held on **August 31, 2010** at **10 A.M.** at the office of the Washington County Service Authority. Bidders are strongly encouraged to attend.

A non-mandatory Pre-Bid Meeting on the Middle Fork Water Treatment Plant Upgrade to 12 MGD Project will be held on **August 31, 2010** at **1 P.M.** at the office of the Washington County Service Authority. Bidders are strongly encouraged to attend.

August 8, 2010
Date

Instructions to Bidders

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ARTICLE 1 - DEFINED TERMS

1.01 Terms used in these Instructions to Bidders will 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. BIDDER – One who submits a Bid directly to OWNER as distinct from a sub-bidder, who submits a Bid to a BIDDER.

B. Issuing Office--The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

C. Successful BIDDER – The lowest, responsible, and responsive BIDDER to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award.

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents in the number and for the cost stated in the Advertisement for Bids may be obtained from the Issuing Office. No refund will be issued.

2.02 Complete sets of Bidding Documents must 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 confer a license or grant for any other use.

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, within five days of Owner's request, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be called for below.

ARTICLE 4 - EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 Subsurface and Physical Conditions

A. The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents.
2. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Bidding Documents.

B. Copies of reports and drawings referenced in paragraph 4.01.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in paragraph 4.02 of the General Conditions has been identified and established in paragraph 4.02 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 Underground Facilities

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

4.03 Hazardous Environmental Condition

A. The Supplementary Conditions identify those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that ENGINEER has used in preparing the Bidding Documents.

B. Copies of reports and drawings referenced in paragraph 4.03.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in paragraph 4.06 of the General Conditions has been identified and established in paragraph 4.06 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.04 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 conditions appear in paragraphs 4.02, 4.03, and 4.04 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 4.06 of the General Conditions.

4.05 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.06 Reference is made to Article 7 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of Contract Documents (other than portions thereof related to price) for such other work.

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

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

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

C. Become familiar with and satisfy Bidder as to all Federal, State, and local Laws and Regulations that may affect cost, progress, or performance of the Work;

D. Carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in paragraph 4.02 of the General Conditions, and (2) reports and drawings of Hazardous Environmental Conditions at the Site which have been identified in the Supplementary Conditions as provided in paragraph 4.06 of the General Conditions;

E. Obtain and carefully study (or accept consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto;

F. Agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents; RUS Bulletin 1780-26 Exhibit E 9/2003

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. Correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations,

explorations, tests, studies, and data with the Bidding Documents;

I. 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; and

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

4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 - PRE-BID CONFERENCE

5.01 A pre-bid conference will be held at OWNER's Office on August 31, 2010 at 1:00 PM. 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 6 - SITE AND OTHER AREAS

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

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 sueh questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than five 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, or change the Bidding Documents as deemed advisable by Owner or Engineer.

ARTICLE 8 - BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 % of Bidder's maximum Bid price and in the form of a certified check or a Bid bond (EJCDC No. C-430, 2002 Edition) issued by a surety meeting the requirements of paragraphs 5.01 and 5.02 of the General Conditions.

8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid

security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.

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

ARTICLE 9 - CONTRACT TIMES

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

ARTICLE 10 -LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages are set forth in the Agreement.

ARTICLE 11 - SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, or "or-equal" materials and equipment as defined in paragraph 6.05 of the General Conditions, or those substitute materials and equipment approved by the Engineer and identified by Addendum. The materials and equipment described in the Bidding Documents establish a standard of required type, function and quality to be met by any proposed substitute or "or-equal" item. Request for Engineer's clarifieation of materials and equipment considered "or-equal" prior to the Effective Date of the Agreement must be received by the Engineer at least 5 days prior to the date for receipt of Bids. No item of material or equipment will be considered by Engineer as a substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids. Each request shall conform to the requirements of paragraph 6.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon the Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any proposed substitute item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner.

ARTICLE 12 - SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. 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, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, without an increase in the Bid.

12.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest responsible Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner and Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer

subject to revocation of such acceptance after the Effective Date of the Agreement as provided in paragraph 6.06 of the General Conditions.

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

12.04 The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 6.06.

ARTICLE 13 - PREPARATION OF BID

13.01 The Bid form is included with the Bidding Documents. Additional copies may be obtained from Engineer.

13.02 All blanks on the Bid form shall be completed by printing in ink or by typewriter and the Bid signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid From. A Bid price shall be indicated for each unit price item listed therein, or the words "No Bid," "No Change," or "Not Applicable" entered.

13.03 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. If required by State where work is to be performed, the corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporation business address and state of incorporation shall be provided on the Bid Form.

13.04 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 business address of the partnership shall be provided on the Bid Form.

13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the business address of the firm must be provided on the Bid Form.

13.06 A Bid by an individual shall show the Bidder's name and business address.

13.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid form. The business address of the joint venture must be provided on the Bid Form.

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

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers and dates of which shall be filled in on the Bid form.

13.10 The address and telephone number for communication regarding the Bid shall be shown.

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

ARTICLE 14 - BASIS OF BID; COMPARSION OF BIDS

14.01 Lump Sum

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

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 the Bid bond form. The unbound copy of the Bid Form is to be completed and submitted with all the attachments outlined in Article 7 of the Bid Form.

15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement for Bids and shall be enclosed in an opaque sealed envelope plainly marked 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 envelope plainly marked on the outside with the notation "BID ENCLOSED." When using the mail or other delivery system, the Bidder is totally responsible for the mail or other delivery system delivering the Bid at the place and prior to the time indicated in the Advertisement for Bid. A mailed Bid shall be addressed to Owner at address in Article 1.01 of Bid Form.

ARTICLE 16 - MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the 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.

16.02 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 or negotiated, that Bidder will be disqualified from further bidding on the Work. This provision to withdraw a Bid without forfeiting the Bid security does not apply to Bidder's errors in judgment in preparing the Bid.

ARTICLE 17 - OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Advertisement for Bids and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the 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.

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 further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to be non-responsible. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

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

19.03 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.

19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the Work in accordance with the contract Documents.

19.06 If the Contract is to be awarded, Owner will award the Contract to the responsible Bidder whose Bid, conforming with all the material terms and conditions of the Instructions to Bidders, is lowest, price and other factors considered.

ARTICLE 20 - CONTRACT SECURITY AND INSURANCE

20.01 Article 5 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 executed Agreement to Owner, it must be accompanied by such bonds.

ARTICLE 21 - SIGNING OF AGREEMENT

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

21.02 This Contract is expected to be funded in part with funds provided by the United States Department of Agriculture, Rural Utilities Service (RUS). Refer to Article 18 of the General Conditions for information on the Federal Requirements.

21.03 Concurrence by RUS in the award of the Contract is required before the Contract is effective.

ARTICLE 22 - SALES AND USE TAXES - NOT USED

ARTICLE 23 – DEFINITION OF ALTERNATES

23.01 The following description of Alternates shall refer to the Schedule of Bid Alternates listed in paragraph 5.01 of Section 00410 – *Bid Form*. These additive bid alternates will be accepted in the order as listed on the Bid Form as budget allows.

A. Alternate A1 – Add Chlorine Scrubber: Alternate A1 is an additive alternate to the Total Base Bid price quoted in Section 00300 – *Bid Form*. This alternate includes furnishing and installing the proposed Chlorine Scrubber as outlined in specification Section 11930 and as detailed on the drawings. Work includes but is not necessarily limited to furnishing and installing the proposed scrubber, ductwork in and out of the chlorine room to the scrubber, concrete pad, electrical and control work to operate the system, and all other appurtenances as required for a complete installation.

B. Alternate A2 – Add Middle Fork Intake Improvements: Alternate A2 is an additive alternate to the Total Base Bid price quoted in Section 00300 – *Bid Form*. This alternate includes furnishing and installing all of the work outlined on drawings M101, M102, E102, and associated site piping.

C. Alternate A3 – Add Caustic Bulk Storage Facilities: Alternate A3 is an additive alternate to the Total Base Bid price quoted in Section 00300 – *Bid Form*. This alternate includes furnishing and installing the caustic bulk storage tank, one caustic bulk transfer pump, the caustic day tank, and all associated piping and valves between the two as shown on the site plan and specifically detailed on the mechanical/process and electrical drawings. Work includes but is not necessarily limited to furnishing and installing the bulk caustic tank, the containment area for the tank complete with roof over the caustic facilities, one bulk transfer pump, the bulk transfer piping/valves for the caustic, drain piping for the caustic containment, the caustic day tank, and all electrical and instrumentation components associated with the caustic bulk facilities. The caustic metering pumps and piping is not part of this alternative and shall be included in the base bid.

D. Alternate A4 – Existing Rapid and Flocculation Mixer Improvements: Alternate A4 is an additive alternate to the Total Base Bid price quoted in Section 00300 – *Bid Form*. This alternate includes furnishing and installing the replacement equipment for the existing flash mixers and the existing flocculation mixers. Work includes but is not necessarily limited to furnishing and installing replacement motors and gear boxes for the existing rapid mixers (M-102 and M-103) and furnishing and installing replacement motors, gear boxes and extending the shafts of the existing flocculation mixers (M-104, M-105, and M-106) as well as the 1' concrete pad under each mixer. The VFDs for these mixers and electrical feeders to the chemical feed building is not part of this alternative and shall be included in the base bid.

E. Alternate B – Add Energy Recovery Improvements: Alternate B is an additive alternate to the Total Base Bid price quoted in Section 00300 – *Bid Form*. This alternate includes all work identified as part of the constructing the Energy Recovery Building including all architectural, civil, structural, mechanical, and electrical components. This work also includes the raw water and sampling line piping work associated with the building as outlined on Drawing C106.

ARTICLE 24 – DAVIS-BACON AND RELATED ACTS

24.01 The Work under this Contract is subject to the provisions of the Davis-Bacon and Related Acts, as published in the U.S. Department of Labor regulations (29 CFR Parts 1, 3, and 5). The Contractor must comply with the minimum rates for wages for laborers and mechanics as determined by the Secretary of Labor in accordance with the provisions of the Davis-Bacon and Related Acts. Refer to paragraph 18.02.C of the Supplementary Conditions for the Labor Standards Provisions clauses that are part of this Contract.

ARTICLE 25 – BUY AMERICAN REQUIREMENT UNDER SECTION 1605 OF THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009

25.01 This Contract is expected to be funded in whole or in part using funds from the American Recovery and Reinvestment Act (ARRA). Section 1605 of the ARRA prohibits the use of these funds unless all iron, steel, and manufactured goods are produced in the United States. All iron and steel manufacturing processes must take place in the United States, except for metallurgical proeesses involving refinement of steel additives. There is no requirement for the origin of components and subcomponents of manufactured goods. Products listed at 48 CFR 25.104(a) have been determined to be unavailable in the United States and if required for the project may be purchased from foreign sources. No unauthorized use of foreign iron, steel, and/or manufactured goods will be allowed on this project.

Bid Form

Project Identification: Washington County Service Authority Middle Fork WTP Upgrade to 12 MGD.

Contract Identification and Number: Middle Fork WTP Upgrade to 12 MGD, 12367.13.

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ARTICLE 1 - BID RECIPIENT

1.01 This Bid Is Submitted To: Washington County Service Authority, 25122 Regal Drive, Abingdon, VA 24211.

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 the Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 - BIDDER'S ACKNOWLEDGMENTS

2.01 Bidder accepts all of the terms and conditions of the Advertisement and Instructions to Bidders, including without limitations those dealing with the dispositions of Bid security. The Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

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

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

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

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in SC-4.02, and (2) reports and drawings of a Hazard Environmental Condition, if any, which has been identified in SC-4.06.

E. Bidder has obtained and carefully studied (or accepts the consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by the Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is 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. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

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

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

K. Bidder will submit written evidence of its authority to do business in the State where the Project is located not later than the date of its execution of the Agreement.

ARTICLE 4 - FURTHER REPRESENTATIONS

4.01 Bidder further represents that:

A. This Bid is genuine and not made in the interest of or on the behalf of any undisclosed individual or entity and is not submitted in conformity with any 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 sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

4.02 In connection with major items of equipment to be furnished and installed in this Project, BIDDER expressly agrees to the following provisions:

A. That the Total Base Bid Price stated above includes the furnishing and installing of major equipment, products and systems furnished by the Supplier which BIDDER has selected from those suppliers listed in Section 01062 – *Major Equipment and Systems Suppliers*; and BIDDER has circled the name of the selected Supplier in Column E of the Schedule of Proposed Equipment Suppliers form at the end of this Section.

B. That the installed price of the equipment, products and systems includes the cost (if any) of changes in the piping, wiring, accessories, etc., necessary to accommodate the particular equipment, products or systems proposed.

C. The Schedule of Proposed Equipment Suppliers found at the end of this Section 00300 shall be binding in terms of the selected equipment, products, systems and suppliers to be provided by the BIDDER under the Total Base Bid Price.

ARTICLE 5 - BASIS OF BID

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

Base Bid Schedule

Item No.	Description	Unit	Quantity	Unit Price	Extended Total Price
1	Bonds, Mobilization, and Insurance	LS	1	$	$
2	Middle Fork WTP Construction	LS	1	$	$
3	Specified Allowances:				
	a. Adsorption Clarifier Equipment	LS	1	$	$
	b. Pump Control Valves	LS	1	$	$
	c. Variable Frequency Drives and Control Equipment	LS	1	$	$
4.	Over Excavation and Backfill	CY	2,000	$	$

Total Base Bid Price ($ _____)

(In Figures)

_____

(In Words)

Additive Bid Alternate Schedule

Item No.	Description	Unit Price
A1	Add Chlorine Scrubber	$ _____ *(In Figures)*
	_____ *(In Words)*	
A2	Add Middle Fork Intake Improvements	$ _____ *(In Figures)*
	_____ *(In Words)*	
A3	Add Caustic Bulk Storage Facilities	$ _____ *(In Figures)*
	_____ *(In Words)*	
A4	Add Existing Rapid and Flocculation Mixer Improvements	$ _____ *(In Figures)*
	_____ *(In Words)*	
B	Add Energy Recovery Improvements	$ _____ *(In Figures)*
	_____ *(In Words)*	

A. All specified allowances are included in the price(s) set forth above, and have been computed in accordance with Paragraph 11.02 of the General Conditions.

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 14.07.B 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 in the event of failure to complete the work within the Contract Times.

ARTICLE 7 - ATTACHEMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of the Bid:

A. Required Bid security in the form of a Bid Bond (EJCDC No. C-430) or Certified Check (circle type of security provided);

B. If Bid amount exceeds $10,000, signed Compliance Statement (RD 400-6). Refer to specific equal opportunity requirements set forth in paragraph 18.10 of the General Conditions;

C. If Bid amount exceeds $25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions (AD-1048);

D. If Bid amount exceeds $100,000, signed RD Instruction 1940-Q, Exhibit A-1, Certification for Contracts, Grants, and Loans. Refer to paragraph 18.11 of the General Conditions; and

E. Required bidder qualifications statement with supporting data.

ARTICLE 8 - DEFINED TERMS

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

SCHEDULE OF PROPOSED MAJOR EQUIPMENT SUPPLIERS				
A	B	C	D	E
Item	Spec. Section	Description	Prequalified "Major Equipment Manufacturers"	Identify "Supplier or Manufacturer" Included in Bidder's Base Bid Price by circling one of the following[1]
a.	11025	Filter Units	a. Infilco Degremont, Inc. b. The F.B. Leopold Company, Inc. c. Roberts Water Technologies, Inc. d. Or approved equal	a. Infilco Degremont, Inc. b. The F.B. Leopold Company, Inc. c. Roberts Water Technologies, Inc. d. Or approved equal
b.	11070	Pumping Equipment: Submersible Chopped Type (Add Alternate A2)	a. Vaughn Co., Inc. b. Haywood Gordon, Inc. c. Or approved equal	a. Vaughn Co., Inc. b. Haywood Gordon, Inc. c. Or approved equal
c.	11072	Pumping Equipment: Vertical Turbine	a. Fairbanks-Morse b. Peerless c. Goulds d. Or approved equal	a. Fairbanks-Morse b. Peerless c. Goulds. d. Or approved equal
d.	11152	Mixing Equipment – Submersible (Add Alternate A2)	a. Wilco EMU b. Landin c. ITT Flyght d. Or approved equal	a. Wilco EMU b. Landin c. ITT Flyght d. Or approved equal
e.	11240	Chemical Transfer & Metering Pumps (Peristaltic) (Base Bid & Alternate A5)	a. Watson-Marlow/Bredel b. Verdeflex Pumps c. Or approved equal	a. Watson-Marlow/Bredel b. Verdeflex Pumps c. Or approved equal
f.	11927	Chemical Feed: Bulk Transfer System	a. Pulsafeeder b. Goulds	a. Pulsafeeder b. Goulds
g.	11880	Powdered Activated Carbon (PAC) Dry Chemical Feeder	a. Siemens b. Or approved equal	a. Siemens b. Or approved equal

SCHEDULE OF PROPOSED MAJOR EQUIPMENT SUPPLIERS				
A	B	C	D	E
Item	Spec. Section	Description	Prequalified "Major Equipment Manufacturers"	Identify "Supplier or Manufacturer" Included in Bidder's Base Bid Price by circling one of the following[1]
h.	11930	Chlorine Vapor Scrubber System (Add Alternate A1)	a. Purafil, Inc. b. Severn Trent c. Or approved equal	a. Purafil, Inc. b. Severn Trent c. Or approved equal
i.	11948	Flocculation Basin Mixers (Base Bid and Alternate A4)	a. Sharpe Mixers b. Lighting Mixing Equipment Co. c. Philadelphia Mixer Corp. d. Chemineer, Incorporated e. Or approved equal	a. Sharpe Mixers b. Lighting Mixing Equipment Co. c. Philadelphia Mixer Corp. d. Chemineer, Incorporated e. Or approved equal
j.	11999	In-Line Static Mixers	a. Komax System, Inc. b. Chemineer, Incorporated c. Koflow Corporation d. Or approved equal	a. Komax System, Inc. b. Chemineer, Incorporated c. Koflow Corporation d. Or approved equal
k.	13200	Fiberglass Reinforeed Plastic Tank (Base Bid and Alternate A3)	a. Augusta Fiberglass b. Plas-Tanks Industries c. Advance Fiberglass, Inc. d. Diamond Fiberglass e. Or approved equal	a. Augusta Fiberglass b. Plas-Tanks Industries c. Advance Fiberglass, Inc. d. Diamond Fiberglass e. Southeastern Fiberglass f. Or approved equal
l.	17000	Control & Information System Scope & General Requirements (System Integrators)	a. Sherwood-Logan b. Systems East c. American Mine Research d. Piedmont Automation e. Or approved equal	a. Sherwood-Logan b. Systems East c. American Mine Research d. Piedmont Automation e. Or approved equal

Notes: (1) Instructions for listing supplier or manufacturer included in BIDDER's Base Bid Price under Column E:

a. Circle name of one supplier or manufacturer for each item listed under Column A to be included in the BIDDER's Base Bid Price.

b. Proposal shall be considered irregular and subject to rejection if BIDDER:

1) Fails to list (by circliug) an approved Supplier or Manufacturer listed under Column E.

2) Lists (circles) more than one approved Supplier or Manufacturer listed under Column E.

c. If BIDDER fails to list (circle) an approved Supplier or Manufacturer, Owner has the sole right to select one of the Suppliers or Manufacturers from the list of acceptable Suppliers and Manufacturers under Column D for the Base Bid Price.

d. If the BIDDER lists (circles) more than one approved Supplier or Manufacturer, the Owner has the sole right to select one of the Suppliers or Manufacturers so listed for the Base Bid Price.

e. Refer to Section 01062 – *Major Equipment and Systems Suppliers* and Section 01640 – *Product Substitutions* for additional details.

ARTICLE 9 - BID SUBMITTAL

9.01 This Bid submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

SEAL, if required by State

Doing business as: _____

A Partnership

Partnership Name: _____

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

SEAL, if required by State

Name (typed or printed): _____

A Corporation

Corporation Name: _____

State of Ineorporation: _____

Type (General Business, Profession, Service, Limited Liability): _____

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

Name (typed or printed): _____

Title: _____

Attest: _____
(Signature of Corporate Secretary)

CORPORATE SEAL, If required by State

Date of Qualification to do business in _____ [State where Project is located] is ___/___/_____

A Joint Venture

Name of Joint Venture: _____

First Joint Venture Name: _____

SEAL, if required by State

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

Name (typed or printed): _____

Title: _____

Second Joint Venture Name: _____

SEAL, if required by State

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

Name (typed or printed): _____

Title: _____

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

Bidder's Business address:

_____

_____

Business Phone No. (_____)_____

Business FAX No. (_____)_____

Business E-Mail Address _____

State Contractor License No. _____. (If applicable)

Employer's Tax ID No. _____

Phone and FAX Numbers, and Address for receipt of official communications, if different from Business contact information:

_____

_____

9.02 Bid submitted on _____, 20___.

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): Washington County Service Authority
25122 Regal Drive
Abingdon, VA 24211

BID
Bid Due Date:
Project (Brief Description Including Location): Middle Fork WTP Interim Improvements
Washington County Service Authority

BOND
Bond Number:
Date (Not later than Bid due date):
Penal sum _____ _____
(Words) (Figures)

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

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

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

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

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

3. This obligation shall be null and void if:
   3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
   3.2. All Bids are rejected by Owner, or
   3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

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

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

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

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

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

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

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

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

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

THIS AGREEMENT is by and between Washington County Service Authority ("Owner") and

_____ ("Contractor").

Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, 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:

Washington County Service Authority Middle Fork WTP Upgrade to 12 MGD

ARTICLE 2 – THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Washington County Service Authority Middle Fork WTP Upgrade to 12 MGD

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by The Lane Group (Engineer), who is 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 *Days to Achieve Substantial Completion and Final Payment*

A. The Work will be substantially completed within 600 days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 660 days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense,

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and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner $1,000 for each day that expires after the time specified in Paragraph 4.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $1,000 for each day that expires after the time specified in Paragraph 4.02 for completion and readiness for final payment 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 an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A, ~~5.01.B, and 5.01.C~~ below:

A. For all Work other than Unit Price Work, a Lump Sum of:

_____ ($_____)
(words) (figure)

All specific cash allowances are included in the above price and have been computed in accordance with paragraph 11.02 of the General Conditions.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 14 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 5th day of each month during performance of the Work as provided in Paragraphs 6.02.A.1 and 6.02.A.2 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements:

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions:

   a. 95 percent of Work completed (with the balance being retainage); and

   b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

2. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions.

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6.03 *Final Payment*

A. Upon receipt of the final Application for Payment accompanied by Engineer's recommendation of payment in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay Contractor as provided in Paragraph 14.07 of the General Conditions the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages.

ARTICLE 7 – INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the maximum legal rate.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

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

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

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

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

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site which has been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

E. Contractor has obtained and carefully studied (or assumes responsibility for doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.

F. Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

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 correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

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I. 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.

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

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages 1 to 1, inclusive).
2. Performance bond (pages _____ to _____, inclusive).
3. Payment bond (pages _____ to _____, inclusive).
4. Other bonds (pages _____ to _____, inclusive).
   a. _____ (pages _____ to _____, inclusive).
   b. _____ (pages _____ to _____, inclusive).
   c. _____ (pages _____ to _____, inclusive).
5. General Conditions (pages _____ to _____, inclusive).
6. Supplementary Conditions (pages _____ to _____, inclusive).
7. Specifications as listed in the table of contents of the Project Manual.
8. Drawings consisting of _____ sheets with each sheet bearing the following general title: _____.
9. Addenda (numbers _____ to _____, inclusive).
10. Exhibits to this Agreement (enumerated as follows):
    a. Contractor's Bid (pages _____ to _____, inclusive).
    b. Documentation submitted by Contractor prior to Notice of Award (pages _____ to _____, inclusive).
    c. _____.
11. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
    a. Notice to Proceed (pages _____ to _____, inclusive).
    b. Work Change Directives.
    c. Change Order(s).

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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 Paragraph 3.04 of 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. 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, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment 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 partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

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 *Other Provisions*

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

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This Agreement is dated _____. This Agreement shall not be effective unless and until Agency's designated representative concurs.

OWNER:	CONTRACTOR
Washington County Service Authority	_____
By: _____	By: _____
Title: _____	Title: _____
[CORPORATE SEAL]	[CORPORATE SEAL]
Attest: _____	Attest: _____
Title: _____	Title: _____
Address for giving notices:	Address for giving notices:
_____	_____
_____	_____
_____	_____
	Agent for service of process:
	_____
	(If Contractor is a corporation or a partnership, attach evidence of authority to sign.)

Agency Concurrence:
As lender or insurer of funds to defray the costs of this Contract, and without liability for any payments thereunder, the Agency hereby concurs in the form, content, and execution of this Agreement.

Agency: _____	By: _____
Date: _____	Title: _____

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SECTION 00600

SUPPLEMENTAL / CONTRACT FORMS

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Notice of Award

Dated _____

Project:	Owner:	Owner's Contract No.:
Middle Fork WTP Upgrade to 12 MGD	**Washington County Service Authority**	
Contract:		Engineer's Project No.:
Middle Fork WTP Upgrade to 12 MGD		**12367.13**
Bidder:		
Bidder's Address (send Certified Mail, Return Receipt Requested)		

You are notified that your Bid dated _____ for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for _____

_____

_____

(Indicate total Work, alternates or sections or Work awarded.)

The Contract Price of your Contract is _____

_____ Dollars ($_____).

_____ copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award.

_____ sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within 15 days of the date you receive this Notice of Award.

1. Deliver to the Owner 5 fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security Bonds as specified in the Instructions to Bidders (Article 20), and General Conditions (Paragraph 5.01).
3. Other conditions precedent:

   _____

   _____

   _____

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

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

_____
Owner

By: _____
Authorized Signature

_____
Title

Copy to Engineer

Notice to Proceed

Dated ____

Project:	Owner:	Owner's Contract No.:
Middle Fork WTP Upgrade to 12 MGD	Washington County Service Authority	
Contract:		Engineer's Project No.:
Middle Fork WTP Upgrade to 12 MGD		12367.13

Contractor:

Contractor's Address: [send Certified Mail, Return Receipt Requested]

You are notified that the Contract Times under the above contract will commence to run on____. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement, the number of days to achieve Substantial Completion is ___ and the number of days to achieve readiness for final payment is __.

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must [add other requirements]:

____

____

____

Washington County Service Authority

Owner

Given by:

Authorized Signature

Title

Date

Copy to Engineer

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Middle Fork WTP Upgrade to 12 MGD	Washington County Service Authority	
Contract:		Date of Contract:
Middle Fork WTP Upgrade to 12 MGD		
Contractor:		Engineer's Project No.:
		12367.13

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

Description:

Attachments: (List documents supporting change):

CHANGE IN CONTRACT PRICE:	CHANGE IN CONTRACT TIMES:
Original Contract Price:	Original Contract Times: ☐ Working days ☐ Calendar days
$_____	Substantial completion (days or date): _____
	Ready for final payment (days or date): _____
[Increase] [Decrease] from previously approved Change Orders No._____ to No._____:	[Increase] [Decrease] from previously approved Change Orders No._____ to No._____:
$_____	Substantial completion (days): _____
	Ready for final payment (days): _____
Contract Price prior to this Change Order:	Contract Times prior to this Change Order:
$_____	Substantial completion (days or date): _____
	Ready for final payment (days or date): _____
[Increase] [Decrease] of this Change Order:	[Increase] [Decrease] of this Change Order:
$_____	Substantial completion (days or date): _____
	Ready for final payment (days or date): _____
Contract Price incorporating this Change Order:	Contract Times with all approved Change Orders:
$_____	Substantial completion (days or date): _____
	Ready for final payment (days or date): _____

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

Approved by Funding Agency (if applicable): _____ Date: _____

Change Order

Instructions

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Times. Changes that have been initiated by a Work Change Directive must be incorporated into a subsequent Change Order if they affect Price or Times.

Changes that affect Contract Price or Contract Times should be promptly covered by a Change Order. The practice of accumulating Change Orders to reduce the administrative burden may lead to unnecessary disputes.

If Milestones have been listed in the Agreement, any effect of a Change Order thereon should be addressed.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Times, a Field Order should be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer normally initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer has completed and signed the form, all copies should be sent to Owner or Contractor for approval, depending on whether the Change Order is a true order to the Contractor or the formalization of a negotiated agreement for a previously performed change. After approval by one contracting party, all copies should be sent to the other party for approval. Engineer should make distribution of executed copies after approval by both parties.

If a change only applies to price or to times, cross out the part of the tabulation that does not apply.

PERFORMANCE BOND

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

CONTRACTOR (Name and Address):

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

OWNER (Name and Address): Washington County Service Authority
25122 Regal Drive
Abingdon, VA 24211

CONTRACT
Date:
Amount:
Description (Name and Location): Middle Fork WTP Upgrade to 12 MGD
Washington County Service Authority

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

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

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

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

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-610 (2002 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General ntractors of America, and the American Institute of Architects.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4 1, 4.2, or 4 3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for

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

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

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

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

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

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

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

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

12. Definitions.

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

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

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

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

FOR INFORMATION ONLY – Name, Address and Telephone		
Surety Agency or Broker		
Owner's Representative (engineer or other party):	Olver Incorporated 1116 South Main Street Blacksburg, VA 24060 (540) 552-5548	The Lane Group 124 Depot Avenue Chilhowie, VA 24319 (276) 646-2520

PAYMENT BOND

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

CONTRACTOR (*Name and Address*):

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

OWNER (*Name and Address*):

CONTRACT

Effective Date of Agreement:
Amount:
Description *(Name and Location)*:

BOND

Bond Number:
Date (*Not earlier than Effective Date of Agreement*):
Amount:
Modifications to this Bond Form:

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

CONTRACTOR AS PRINCIPAL		**SURETY**	
_____ (Seal)		_____ (Seal)	
Contractor'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: Provide execution by additional parties, such as joint venturers, if necessary.

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

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

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

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

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

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

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

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

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

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

6. Reserved.

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

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

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

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

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

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

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

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

15. Definitions

15.1 Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

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

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

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

CERTIFICATE OF INSURANCE

Issue Date (MM/DD/YY)

PRODUCER

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND, OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

COMPANIES AFFORDING COVERAGE

COMPANY LETTER	A	
COMPANY LETTER	B	
COMPANY LETTER	C	
COMPANY LETTER	D	
COMPANY LETTER	E	

INSURED

COVERAGES

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS, AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
	GENERAL LIABILITY ☐ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS MADE ☐ OCCUR. ☐ OWNER'S & CONTRACTOR'S PROT. ☐ _____				GENERAL AGGREGATE	$
					PRODUCTS-COMP/OP AGG.	$
					PERSONAL & ADV. INJURY	$
					EACH OCCURRENCE	$
					FIRE DAMAGE (Any one fire)	$
					MED. EXP. (Any one person)	$
	AUTOMOBILE LIABILITY ☐ ANY AUTO ☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS ☐ HIRED AUTOS ☐ NON-OWNED AUTOS ☐ GARAGE LIABILITY ☐ _____				COMBINED SINGLE LIMIT	$
					BODILY INJURY (Per person)	$
					BODILY INJURY (Per accident)	$
					PROPERTY DAMAGE	$
	EXCESS LIABILITY ☐ UMBRELLA FORM ☐ OTHER THAN UMBRELLA FORM				EACH OCCURRENCE	$
					AGGREGATE	$
	WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY				☐ STATUTORY LIMITS	
					EACH ACCIDENT	$
					DISEASE-POLICY LIMIT	$
					DISEASE-EACH EMPLOYEE	$
	OTHER					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL PROVIDE SIXTY (60) DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT VIA REGISTERED OR CERTIFIED MAIL.

AUTHORIZED REPRESENTATIVE

CERTIFICATE INSURANCE 10/96

SPECIAL PROVISIONS

The insurance requirements prescribed by Section 00700 - General Conditions and Section 00805 - Supplementary Conditions are the minimum that will be acceptable. The OWNER and ENGINEER shall be indicated on all policies, in name and not genre, as the additional insured with respect to all insurance requirements.

The OWNER shall be provided with written notice, at least 30 days prior to any cancellation or modification of the insurance policies held by CONTRACTOR in connection with this project.

The General Liability Policy listed on this certificate contains no restrictive clauses, relating to excavating, driving of sheet piling, moving, shoring, underpinning, removal and rebuilding of structural supports, collapse, underground damage, subsurface work, explosion, blasting and other use of explosives, which would limit the insurance.

The exclusion in the property damage section relating to property in the care, custody and control of the Insured has been eliminated from the General Liability Policy listed on this Certificate.

The Contractual Liability Insurance provided by the General Liability Policy listed on this Certificate insures all of the provisions of Article 4 of the General Conditions and Supplementary Conditions between the Insured and the OWNER.

COMMONWEALTH OF VIRGINIA

CONTRACTOR'S POLICY OF DRUG-FREE WORKPLACE

Pursuant to Section 2.2-4312 of the Code of Virginia, 1950, as amended, during the performance of this contract, the Contractor agrees to:

i. Provide a drug-free workplace for the Contractor's employees;

ii. Post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

iii. State in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace; and

iv. Include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this statement, "drug-free workplace" means a site for the performance of work done in connection with this specific contract awarded to Contractor, the employees who are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

_____
Signature of Authorized Agent

_____
Date

Contractor's Application For Payment No. _____

	Application Period:	Application Date:
To (Owner): Washington County Service Authority	From (Contractor):	Via (Engineer): The Lane Group
Project: Middle Fork WTP Interim Improvements	Contract: Middle Fork WTP Upgrade to 12 MGD	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.: 12367.13

APPLICATION FOR PAYMENT

Change Order Summary

Approved Change Orders

Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1.	**ORIGINAL CONTRACT PRICE**	$
2.	**Net change by Change Orders**	$
3.	**CURRENT CONTRACT PRICE (Line 1 ± 2)**	$
4.	**TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)**	$
5.	**RETAINAGE:**	
	a. _____ % x $_____ **Work Completed**	$
	b. _____ % x $_____ **Stored Material**	$
	c. **Total Retainage (Line 5a + Line 5b)**	$
6.	**AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)**	$
7.	**LESS PREVIOUS PAYMENTS (Line 6 from prior Application)**	$
8.	**AMOUNT DUE THIS APPLICATION**	$
9.	**BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above)**	$

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By: _____ Date: _____

Payment of: $_____
(Line 8 or other - attach explanation of other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $_____
(Line 8 or other - attach explanation of other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding Agency (if applicable) (Date)

Progress Estimate

Contractor's Application

For (contract): Middle Fork WTP Upgrade to 12 MGD	Application Number:
Application Period:	Application Date:

A		B	Work Completed		E	F		G
Item			C	D		Total Completed and Stored to Date (C + D + E)	% (F) B	Balance to Finish (B - F)
Specification Section No.	Description	Scheduled Value	From Previous Application (C + D)	This Period	Materials Presently Stored (not in C or D)			
	Totals							

Progress Estimate

Contractor's Application

For (contract): Middle Fork WTP Upgrade to 12 MGD	Application Number:
Application Period:	Application Date:

A				B	C	D	E	F		G
Item		Bid Quantity	Unit Price	Bid Value	Estimated Quantity Installed	Value	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F) B	Balance to Finish (B - F)
Bid Item No.	Description									
	Totals									

Stored Material Summary

Contractor's Application

For (contract): Middle Fork WTP Upgrade to 12 MGD							Application Number:		
Application Period:							Application Date:		
A	B	C	D		E		F		G
Invoice No.	Shop Drawing Transmittal No.	Materials Description	Stored Previously		Stored this Month		Incorporated in Work		
			Date (Month/Year)	Amount ($)	Amount ($)	Subtotal	Date (Month/Year)	Amount ($)	*Materials Remaining* in Storage ($) (D + E - F)
		Totals							

OLVER
INCORPORATED

Field Order _____

Project Name:	MIDDLE FORK WTP UPGRADE TO 12 MGD	Olver Project Number:	12367.13
Project Owner:	WASHINGTON COUNTY SERVICE AUTHORITY	Date:	

ATTENTION:
You are hereby directed to promptly execute this Field Order for minor changes in work without changes in Contract Sum or Contract Time. If you consider that a change in Contract Sum or Contract Time is required, please submit your itemized proposal to Olver immediately and before proceeding with this work. If your proposal is found to be acceptable and in proper order, this Field Order will in that event be superseded by a Change Order.

Reference:

Description:

Attachments:

Receipt Acknowledgment: General Contractor	By: The Lane Group
Date	Date

OLVER
INCORPORATED

Change Proposal Request

(NOT A CHANGE ORDER)

Project Owner:	WASHINGTON COUNTY SERVICE AUTHORITY	Olver Project Number:	12367.13
Project Name:	MIDDLE FORK WTP UPGRADE TO 12 MGD	Date:	
Contractor:		Initiated by: ☐ Engineer ☐ Contractor	

Attention:

The following change in the contract on this project is proposed.

- **A breakdown of cost SHALL be attached.**
- **Work shall not commence until authorized by the Owner.**

Description of the Proposed Change:

By: _____

The Lane Group

All work shall be in accordance with the terms, stipulations, and conditions of the original Contract Documents. If the Work herein provided for is Approved by Change Order, the time of completion will be:

☐ Increased ☐ Decreased ☐ Unchanged by _____ calendar days.

This change will: ☐ Add ☐ Deduct ☐ Not Change

$ _____

By: _____

General Contractor

_____

Date

Olver Recommendation:

☐ Recommend Acceptance ☐ Do Not Recommend Acceptance

By: _____

Olver Incorporated

_____

Date

Owner's Action:

☐ Accepted ☐ Not Accepted

By: _____

Owner

_____

Date

Distribution: ☐ Owner ☐ Contractor ☐ Office ☐ Field ☐ Other

FINAL WAIVER OF LIENS

Date _____

To:

Re:

Dear Sir:

I hereby acknowledge receipt of _____ dollars ($_____) in full payment of my contract dated _____for the improvement work which I completed for you and which is described in my contract.

I certify that I have paid in full for all materials purchased and all labor employed in the performance of this contract, and that there are no claims against me as an employer under this contract on account of injuries sustained by workmen employed by me thereunder. I hereby release you from any claims arising by virtue of this contract.

I am attaching Standard Form "Release by Claimants," signed by all persons from whom I have purchased materials and by all persons employed in connection with my contract with the above-named borrower.

Sincerely,

_____
Contractor

OLVER
INCORPORATED

FINAL RELEASE BY CLAIMANTS

The undersigned, having received payment in full for all labor, materials, supplies, or equipment supplied to_____ Contractor, or to any subcontractor, in the construction or repair of the improvements upon the property located at:

_____

_____

_____

and furnished in the execution and fulfillment of contract between said Contractor and _____, Owner, dated _____, do (does) hereby release and waive any and all claims, liens, and lien rights, or any kind, nature, or description whatsoever, against said property and the Owner thereof, and against said Contractor.

_____

_____

_____

_____

_____

_____

_____

_____
General Contractor's Representative

Certificate of Substantial Completion

Project: Middle Fork WTP Upgrade to 12 MGD	Owner: Washington County Service Authority	Owner's Contract No.:
Contract: Middle Fork WTP Upgrade to 12 MGD		Date of Contract:
Contractor:		Engineer's Project No.. 12367.13

This [tentative] [definitive] Certificate of Substantial Completion applies to:

☐ All Work under the Contract Documents: ☐ The following specified portions:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below.

A [tentative] [revised tentative] [definitive] list of items to be completed or corrected, is attached hereto. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Documents except as amended as follows:

☐ Amended Responsibilities ☐ Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

The following documents are attached to and made part of this Certificate:

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

Executed by Engineer — Date

Accepted by Contractor — Date

Accepted by Owner — Date

USDA
Form RD 400-6
(Rev. 4-00)

Form Approved
OMB No. 0575-0018

COMPLIANCE STATEMENT

This statement relates to a proposed contract with _____

_____,
(Name of borrower or grantee)

who expects to finance the contract with assistance from either the Rural Housing Service (RHS), Rural Business-Cooperative Service (RBS), or the Rural Utilities Service (RUS) or their successor agencies, United States Department of Agriculture (whether by a loan, grant, loan insurance, guarantee, or other form of financial assistance).I am the undersigned bidder or prospective contractor, I represent that:

1. I ☐ have, ☐ have not, participated in a previous contract or subcontract subject to Executive I1246 (regarding equal employment opportunity) or a preceding similar Executive Order.

2. If I have participated in such a contract or subcontract, I ☐ have, ☐ have not, filed all compliance reports that have been required to file in connection with the contract or subcontract.

If the proposed contract is for $50,000 or more and I have 50 or more employees, I also represent that:

3. I ☐ have, ☐ have not previsouly had contracts subject to the written affirmative action programs requirements of the Secretary of Labor.

4. If I have participated in such a contract or subcontract, I ☐ have, ☐ have not developed and placed on file at each establishment affirmative action programs as required by the rules and regulations of the Secretary of Labor.

I understand that if I have failed to file any compliance reports that have been required of me, I am not eligible and will not be eligible to have my bid considered or to enter into the proposed contract unless and until I make an arrangement regarding such reports that is satisfactory to either the RHS, RBS or RUS, or to the office where the reports are required to be filed.

I also certify that I do not maintain or provide for my employees any segregated facilities at any of my establishments, and that I do not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I certify further that I will not maintain or provide for my employees any segregated facilities at any of my establishments, and that I will not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I agree that a breach of this certification is a violation of the Equal Opportunity clause in my contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants and other eating areas time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. I further agree that (except where I have obtained identical certifications for proposed subcontractors for specific time periods) I will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that I will retain such certifications in my files; and that I will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods): (See Reverse).

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0575-0018. The time required to complete this information collection is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATIONS OF NON-SEGREGATED FACILITIES

A certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e. quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

DATE _____ _____

(Signature of Bidder or Prospective Contractor)

_____

Address (including Zip Code)

CERTIFICATION FOR CONTRACTS, GRANTS AND LOANS

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

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

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

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

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

_____ _____

(name) (date)

_____

(title)

oOo

U.S. DEPARTMENT OF AGRICULTURE

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION - LOWER TIER COVERED TRANSACTIONS

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 7 CFR Part 3017, Section 3017.510, Participants' responsibilities. The regulations were published as Part IV of the January 30, 1989, Federal Register (pages 4722-4733). Copies of the regulations may be obtained by contacting the Department of Agriculture agency with which this transaction originated.

(BEFORE COMPLETING CERTIFICATION, READ INSTRUCTIONS ON REVERSE)

(1) The prospective lower tier participant certifies, by submission of this proposal, that neither it not its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

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

Organization Name | PR/Award Number or Project Name

Name(s) and Title(s) of Authorized Representative(s)

Signature(s) | Date

Instructions for Certification

1. By signing and submitting this form, the prospective lower tier participant is providing the certification set out on the reverse side in accordance with these instructions.

2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later than determined that the prospective lower tier participant knowingly
rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

4. The terms "covered transactions," debarred," "suspended," "ineligible,", "lower tier covered transactions," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

5. The prospective lower tier participant agrees by submitting this form that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

6. The prospective lower tier participant further agrees by submitting this form that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.

8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

CONTRACTOR'S QUALIFICATION STATEMENT

All questions must be answered in full. Additional sheets for clarification of answers or additional information may be attached. This statement must be notarized.

1. Name, address, phone number, IRS number (or owner's social security #) of company.

_____
_____
_____
_____

2. Owner, principal officer, date and place organized.

_____
_____
_____
_____

3. General character of work performed.

_____
_____
_____
_____

4. Any work awarded failed to be completed or contracts defaulted on - where and why.

_____
_____
_____
_____

5. List of three most important recent contracts over $30,000. State the owner, work, approximate cost, place, date started and date completed.

1. _____ $_____

   From _____ To _____

2. _____ $_____

   From _____ To _____

3. _____ $_____

   From _____ To _____

6. List the contracts upon which you are currently working. Include owner, location, approximate cost, and estimated date of completion.

_____

_____

_____

_____

7. List your major equipment available for use on this project.

_____

_____

_____

_____

8. List of three material suppliers and amount of credit available.

1. _____ $_____
2. _____ $_____
3. _____ $_____

9. Bank references and credit available.

1. _____ $_____
2. _____ $_____

10.Insurance coverage and amount.

Liability-Property:_____ $_____

Liability-Personal Injury:_____ $_____

Vehicle and Equipment:_____ $_____

Other-_____:_____ $_____
Identify

11.Bonding reference - List surety and highest coverage

_____
_____
_____
_____

12.Subcontractors utilized - List name, address, specialty and years experience.

1._____

2._____

3._____

13.Provide a general description of the experience of the company and its key personnel.

_____
_____
_____
_____

14.Number of current full-time employees _____
Number of employees at highest level in past twelve months _____

15.Are you on any list of debarred contractors maintained by the U.S. Department of Labor, U.S. Department of Housing & Urban Development, or Virginia Department of Highways?

YES ___ NO ___

The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by _____ in verification of the recitals comprising this statement of contractor's qualification:

Contractor: _____

By: _____

Title: _____

Date: _____

STATE OF _____

COUNTY OF _____

_____ being duly sworn deposes and says that

he/she is _____ of _____

and that the answers to the foregoing questions and all statements therein

contained are true and correct.

SUBSCRIBED AND SWORN TO BEFORE ME THIS ____ DAY OF _____, 20__.

_____.
NOTARY PUBLIC

MY COMMISSION EXPIRES _____.

ARRA REQUIRED DOCUMENTS

American Recovery and Reinvestment Act Davis-Bacon Compliance Checklist

Project: Washington County Service Authority Middle Fork Water Treatment Plant Upgrade to 12 MGD

American Recovery and Reinvestment Act funds used for a transaction that involves a new construction or repair contract, exceeding $2,000, must comply with the prevailing wage requirements of the Davis-Bacon and Related Acts requirements. This checklist has been created to provide an overview of the requirements established by the Davis-Bacon and Related Acts requirements as prescribed in RD Instruction 1940-C. This checklist does not substitute for the detailed provisions in RD Instruction 1940-C or the Department of Labor requirements for implementing Davis-Bacon and Related Acts requirements.

As noted in this checklist, the Contracting Officer (CO) is responsible for ensuring that Davis-Bacon and Related Acts requirements are met. The person designated to perform the duties of the CO varies by program. The Administrative Notice identifies the individual or firm responsible as CO for these requirements. The RD Official shall insert the date that each requirement is completed.

Applicable requirements are listed below.

Before awarding a construction or repair contract.

_____ (date) **Informing the Applicant and Reviewing the Contract:** When application is made to the Agency or a guaranteed lender for assistance involving construction, the Agency or approved lender must inform the applicant that wages paid for labor must not be less than the prevailing wages determined by the Secretary of Labor (RD Instruction 1940-C (1940.106(b))). The Agency must review the contract to ensure that it contains the language provided in RD Instruction 1940.105(a) and the DOL website language (see below).

_____ (date) **Wage Determination:** Before bidding, the CO shall download the applicable Department of Labor (DOL) Davis-Bacon Wage Determination for the work from the DOL website at www.wdol.gov/dba.aspx#0 Once on the selection page, the CO chooses the state, county, and Construction Type. Construction Type choices are "All Construction Types", "Building" (public buildings), "Heavy", "Highway", or "Residential". Click on "Search". The CO then scrolls to the bottom, and clicks on "Printer Friendly Version". The CO then clicks on "File", "Print", and inserts the wage determinations into the contract documents.

_____ (date) **Information for Bidders:** Information provided to any and all bidders shall include the statement "The contractor must comply with the minimum rates for wages for laborers and mechanics as determined by the Secretary of Labor in accordance with the provisions of the Davis-Bacon and Related Acts." The CO shall verify this and include a copy of the Wage Determination in the bid information.

_____ (date) **Construction Contract Provisions:** All construction and repair contracts exceeding $2000-must include the statement "The contractor must comply with the minimum rates for wages for laborers and mechanics as determined by the Secretary of Labor in accordance with the provisions of the Davis-Bacon and Related Acts." In addition, labor standards provisions from 29 CFR 5.5(a) must be included in every contract. See www.dol.gov/dol/allcfr/ESA/Title_29/Part_5/toc.htm. (The DOL website includes updated information which meets the requirements of RD Instruction 1940.105(b)).

American Recovery and Reinvestment Act Davis-Bacon Compliance Checklist

After awarding a construction contract and before construction starts

_____ (date) **Pre-Construction Conference:** The CO and other project participants will have a Pre-Construction Conference to discuss the following items. (See requirements of RD Instruction 1940.106(d).)

- The CO, inspectors, or applicant may monitor contractor's adherence to the Davis-Bacon and Related Acts requirements at any time.
- Non-compliance with the Davis-Bacon and Related Acts requirements may result in termination of the contract and debarment of the contractor.
- Enforcement of non-compliance with the Davis-Bacon and Related Acts requirements may result in penalties
- Although the Agency and owner has the right to perform employee interviews, typically information can be confirmed by reviewing progress reports and contractor's typical payroll records.
- The contractor shall maintain posted on site a copy of the Davis-Bacon and Related Acts poster (form WH-1321) and a copy of the wage determination. The poster is available at: www.dol.gov/esa/whd/regs/compliance/posters/davis.htm, with a Spanish version available at www.dol.gov/esa/whd/regs/compliance/posters/davisspan.htm. (The wage determination should have been provided to the contractor as a part of the bid package and the contract.)

During Construction (Monitoring)

_____ (date) **Certification of Compliance:** Contractor and subcontractors must provide certification of compliance with the Davis-Bacon and Related Acts to the CO / approved lender, as well as copies of payroll records for the period during which the work was performed. (See RD Instruction 1940-C (1940.106(e)(1))).

_____ (date) **Determination of Non-compliance:** The project inspector or CO, on determining that the contractor is not in compliance, will notify the appropriate parties, including the Agency and approved lender (if applicable) who will then contact the State Director for advice and further instructions. (Additional information on actions to be taken is available in RD Instruction 1940-C (1940.106(e)(2) and (3), and 1940.106(f)).)

_____ (date) **Semiannual Report**. RD field offices or approved lenders will submit to the State Director Form RD 440-29, "Semiannual Labor Compliance Report," for projects requiring compliance with the Davis-Bacon and Related Acts for the periods established in RD Instruction 1940-C (1940.107(a)). (October through March, and April through September)

_____ (date) **Consolidated Report**. RD State Offices will consolidate all reports received from field offices and approved lenders, and forward copies to the Administrator no later than April 30 and October 31. (See RD Instruction 1940-C (1940.107(b)).)

American Recovery and Reinvestment Act Davis-Bacon Compliance Checklist

After Construction

_____ (date) **Recordkeeping.** The Agency official or approved lender responsible for the project will preserve all payrolls and certifications for a period of 3 years from the date of final payment on the contract. (See RD Instruction 1940-C (1940.108).

_____ Contracting Officer

_____ date

CFR Code of Federal Regulations Pertaining to ESA

└ Title 29 Labor

└ Chapter I Office of the Secretary of Labor

└ Part 5 Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction (Also Labor Standards Provisions Applicable to Nonconstruction Contracts Subject to the Contract Work Hours and Safety Standards Act

└ Subpart A Davis-Bacon and Related Acts Provisions and Procedures

29 CFR 5.5 - Contract provisions and related matters.

. **Section Number:** 5.5

. **Section Name:** Contract provisions and related matters.

(a) The Agency head shall cause or require the contracting office to insert in full in any contract in excess of $2,000 which is enter into for the actual construction, alteration and/or repair, includin painting and decorating, of a public building or public work, or building or work financed in whole or in part from Federal funds or accordance with guarantees of a Federal agency or financed from fund obtained by pledge of any contract of a Federal agency to make a loa grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in Sec. 5.1, the following clau (or any modifications thereof to meet the particular needs of the agency, Provided, That such modifications are first approved by the Department of Labor):

(1) Minimum wages. (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housin Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not le often than once a week, and without subsequent deduction or rebate o any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act CFR part 3)), the full amount of wages and bona fide fringe benefits cash equivalents thereof) due at time of payment computed at rates n less than those contained in the wage determination of the Secretary Labor which is attached hereto and made a part hereof, regardless of contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fri benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more

than a weekly period (but not less often than quarterly) under plans funds, or programs which cover the particular weekly period, are dee to be constructively made or incurred during such weekly period. Suc laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of actually performed, without regard to skill, except as provided in Sec. 5.5(a)(4). Laborers or mechanics performing work in more than o classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That employer's payroll records accurately set forth the time spent in ea classification in which work is performed. The wage determination (including any additional
classification and wage rates conformed under paragraph (a)(1)(ii) o this section) and the Davis-Bacon poster (WH-1321) shall be posted a all times by the contractor and its subcontractors at the site of th work in a prominent and accessible place where it can be easily seen the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract sh be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and w rate and fringe benefits therefore only when the following criteria been met:

(1) The work to be performed by the classification requested is performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the constructi industry; and

(3) The proposed wage rate, including any bona fide fringe benef bears a reasonable relationship to the wage rates contained in the w determination.

(B) If the contractor and the laborers and mechanics to be emplo in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (inclu the amount designated for fringe benefits where appropriate), a repo of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contractin officer or will notify the contracting officer within the 30-day per that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this sect shall be paid to all workers performing work in the classification u this contract from the first day on which work is performed in the classification.

a class of laborers or mechanics includes a fringe benefit which is expressed as an hourly rate, the contractor shall either pay the ben as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or ot third person, the contractor may consider as part of the wages of an laborer or mechanic the amount of any costs reasonably anticipated i providing bona fide fringe benefits under a plan or program, Provide That the Secretary of Labor has found, upon the written request of t contractor, that the applicable standards of the Davis-Bacon Act hav been met. The Secretary of Labor may require the contractor to set a in a separate account assets for the meeting of obligations under th plan or program.

(2) Withholding. The (write in name of Federal Agency or the loa grant recipient) shall upon its own action or upon written request o authorized representative of the Department of Labor withhold or cau to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federa assisted contract subject to Davis-Bacon prevailing wage requirement which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers mechanics, including apprentices, trainees, and helpers, employed by contractor or any subcontractor the full amount of wages required by contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of project), all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause t suspension of any further payment, advance, or guarantee of funds un such violations have ceased.

(3) Payrolls and basic records. (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the co of the work and preserved for a period of three years thereafter for laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages pai (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described i section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number hours
worked, deductions made and actual wages paid. Whenever the Secretar Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any lab or mechanic include the amount of any costs reasonably anticipated i providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain rec which show that the commitment to provide such benefits is enforceab that the plan or program is financially responsible, and that the pl or program has been communicated in writing to the laborers or mecha affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain writt evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentic and trainees, and the ratios and wage rates prescribed in the applic

programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to th (write in name of appropriate federal agency) if the agency is a par to the contract, but if the agency is not such a party, the contract will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency). The payrolls submitted shall set out accurately and completely all of th information required to be maintained under 29 CFR 5.5(a)(3)(i), exc that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only nee to include an individually identifying number for each employee (e.g the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form des Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347inst or its successor site. The prime contractor is responsible for the s of copies of payrolls by all subcontractors. Contractors and subcont shall maintain the full social security number and current address o covered worker, and shall provide them upon request to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency), the contractor, o the Wage and Hour Division of the Department of Labor for purposes o an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and socia security numbers to the prime contractor for its own records, withou weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a ``Statement Compliance,'' signed by the contractor or subcontractor or his or he agent who pays or supervises the payment of the persons employed und the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under Sec. 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under Sec. 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than th applicable wage rates and fringe benefits or cash equivalents for th classification of work performed, as specified in the applicable wag determination incorporated into the contract.

(C) The weekly submission of a properly executed certification s forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the ``Statement of Compliance'' requir by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may sub the contractor or subcontractor to civil or criminal prosecution und section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records

inspection, copying, or transcription by authorized representatives the (write the name of the agency) or the Department of Labor, and s permit such representatives to interview employees during working ho on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failur submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.1

(4) Apprentices and trainees--(i) Apprentices. Apprentices will permitted to work at less than the predetermined rate for the work t performed when they are employed pursuant to and individually regist in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office Apprenticeship Training, Employer and Labor Services, or with a Stat recognized by the Office, or if a person is employed in his or her f 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprenti performing work on the job site in excess of the ratio permitted und the registered program shall be paid not less than the applicable wa rate on the wage determination for the work actually performed. Wher contractor is performing construction on a project in a locality oth than that in which its program is registered, the ratios and wage ra (expressed in percentages of the journeyman's hourly rate) specified the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not speci fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, frin shall be paid in accordance with that determination. In the event th Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the w performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will be permitted to work at less than the predetermined rate for the wor performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced

formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the site shall not be greater than permitted under the plan approved by Employment and Training Administration. Every trainee must be paid a not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journe hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of t trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wag and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate wh not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than t applicable wage rate
on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site excess of the ratio permitted under the registered program shall be not less than the applicable wage rate on the wage determination for work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contrac will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an accept program is approved.

(iii) Equal employment opportunity. The utilization of apprentic trainees and journeymen under this part shall be in conformity with equal employment opportunity requirements of Executive Order 11246, amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor sh comply with the requirements of 29 CFR part 3, which are incorporate reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert i any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (and such other clauses as the (write in the name of the Federal agen may by appropriate instructions require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontrac The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clau in 29 CFR 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a contractor and a subcontractor as provided in CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. Al rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of labor standards provisions of this contract shall not be subject to general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labo set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning o this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility. (i) By entering into this

any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virt of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any pers or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in t U.S. Criminal Code, 18 U.S.C. 1001.

(b) Contract Work Hours and Safety Standards Act. The Agency Hea shall cause or require the contracting officer to insert the followi clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 a subject to the overtime provisions of the Contract Work Hours and Sa Standards Act. These clauses shall be inserted in addition to the clauses required by Sec. 5.5(a) or 4.6 of part 4 of this title. As u in this paragraph, the terms laborers and mechanics include watchmen guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the conract work which may require or involve the employment of laborers or mechanics shall require or per any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workw unless such laborer or mechanic receives compensation at a rate not than one and one-half times the basic rate of pay for all hours work in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. I the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontracto responsible therefor shall be liable for the unpaid wages. In additi such contractor and subcontractor shall be liable to the United Stat (in the case of work done under contract for the District of Columbi a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to e individual laborer or mechanic, including watchmen and guards, emplo in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standa workweek of forty hours without payment of the overtime wages requir by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The (wr in the name of the Federal agency or the loan or grant recipient) sh upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by th contractor or subcontractor under any such contract or any other Fed contract with the same prime contractor, or any other federally-assi contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contra or subcontractor for unpaid wages and liquidated damages as provided the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert i any subcontracts the clauses set forth in paragraph (b)(1) through (of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor lower tier subcontractor with the clauses set forth in paragraphs (b through (4) of this section.

(c) In addition to the clauses contained in paragraph (b), in an contract subject only to the Contract Work Hours and Safety Standard Act and not to any of the other statutes cited in Sec. 5.1, the Agen Head shall cause or require the contracting officer to insert a clau requiring that the contractor or subcontractor shall maintain payrol and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchm working on the contract. Such records shall contain the name and add of each such employee, social security number, correct classificatio hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head sha cause or require the contracting officer to insert in any such contr a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor inspection, copying, or transcription by authorized representatives the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

(The information collection, recordkeeping, and reporting requiremen contained in the following paragraphs of this section were approved the Office of Management and Budget:

Paragraph	OMB Con Numb
(a)(1)(ii)(B)	1215-
(a)(1)(ii)(C)	1215-
(a)(1)(iv)	1215-
(a)(3)(i)	1215-0 1215-
(a)(3)(ii)(A)	1215-
(c)	1215-0 1215-

[48 FR 19540, Apr. 29, 1983, as amended at 51 FR 12265, Apr. 9, 1986; 55 FR 50150, Dec. 4, 1990; 57 FR 28776, June 26, 1992; 58 F 58955, Nov. 5, 1993; 61 FR 40716, Aug. 5, 1996; 65 FR 69674, Nov. 20 73 FR 77511-77512, Dec. 19, 2008]

GENERAL DECISION: VA20100049 03/12/2010 VA49

Date: March 12, 2010
General Decision Number: VA20100049 03/12/2010

Superseded General Decision Number: VA20080049

State: Virginia

Construction Type: Building

Counties: Bristol*, Scott and Washington Counties in Virginia.

*INDEPENDENT CITY

BUILDING CONSTRUCTION PROJECTS (Does not include single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	03/12/2010

PLUM0538-001 03/01/2008

	Rates	Fringes
PIPEFITTER (Including HVAC Work)		
Plumbing and mechanical combined on a project totals less than $1,000,000.	$ 20.71	8.67
Plumbing and mechanical combined on a project totals more than $1,000,000.	$ 23.01	8.67

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* SUVA1995-001 03/23/1995

	Rates	Fringes
ACOUSTICAL CEILING MECHANIC	$ 10.00	
BRICKLAYER	$ 13.25	
Carpenters (Excluding Drywall Hanging, Acoustical Ceiling Installation and Insulation)	$ 10.08	
CEMENT FINISHER	$ 9.63	
Drywall Finisher/Taper (Including Drywall Sanding)	$ 12.00	
Drywall Hanger	$ 10.14	
Electricians	$ 12.28	.50
FENCE ERECTOR (Chain Link Only)	$ 7.25	
Glaziers	$ 11.06	1.36

HVAC MECHANIC (Including Installation; Excluding Duct and Pipe Work)	$ 9.50	
INSTALLER - METAL STUD (For Drywall Framing)	$ 10.88	
Insulator (Excluding Batt and Pipe Insulation)		
Spray - Fireproofing on Steel Frame	$ 9.75	
Laborers:		
Landscape Workers	$ 7.25	
Mason Tenders, Brick	$ 7.91	
Unskilled	$ 7.25	
PAINTER (Brush and Roller) (Excluding Drywall Finishing)	$ 9.83	
PAINTER: Spray Only	$ 10.61	
Plumbers (Excluding HVAC Work)	$ 10.08	.97
Power equipment operators:		
Backhoes	$ 8.80	.75
Bulldozers	$ 8.00	.75
Loaders	$ 8.00	.75
Pavers	$ 7.50	.75
Rollers	$ 8.50	.19
Roofers	$ 7.60	.14
Sheet Metal Worker (Including HVAC Duct Work)	$ 9.46	
Sprinkler Fitters	$ 10.72	1.63
TILE SETTER	$ 11.70	
Truck Driver, Dump	$ 7.25	.75

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)).

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

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

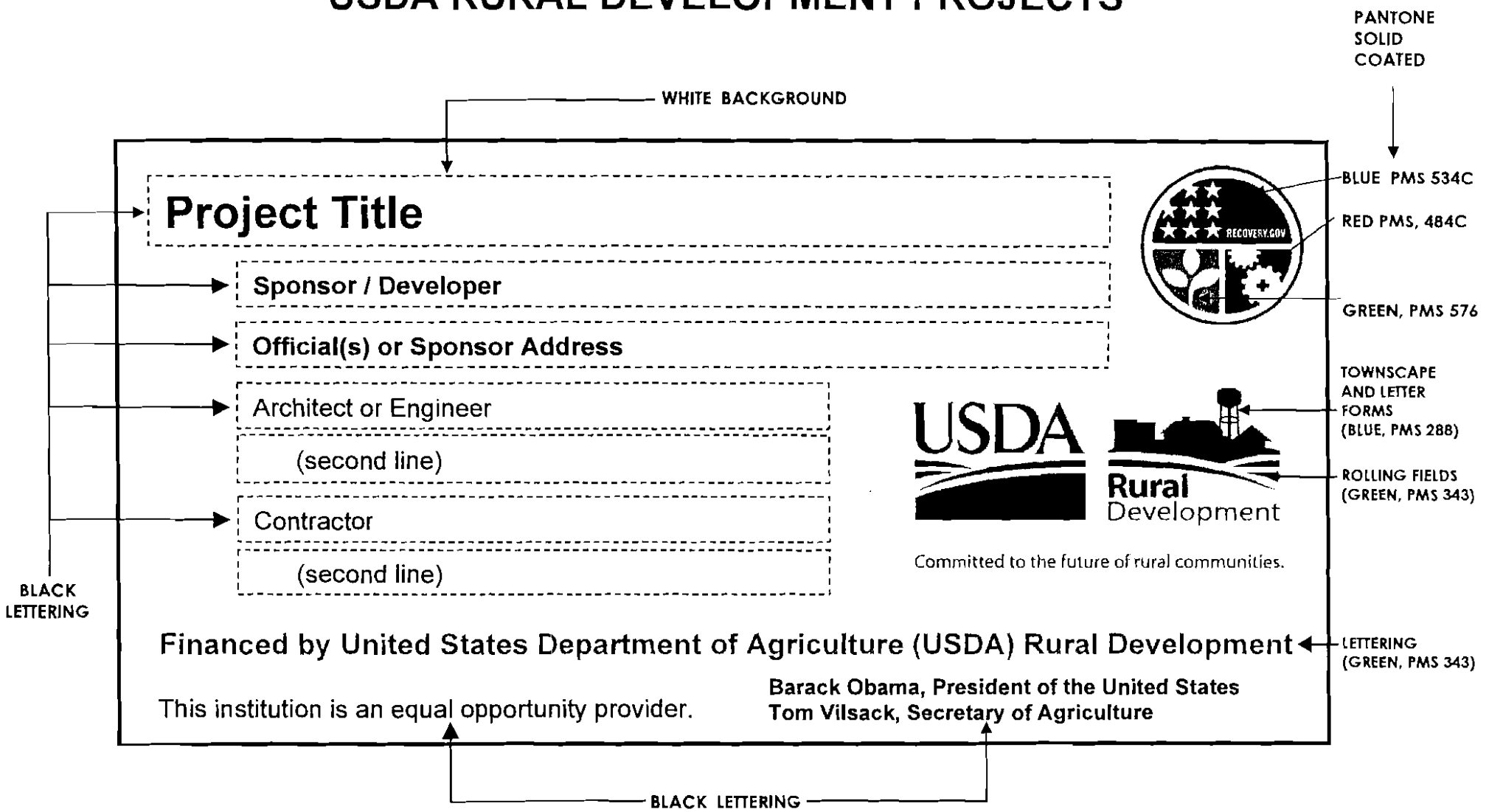
The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

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.

AMERICAN RECOVERY AND REINVESTMENT ACT
TEMPORARY CONSTRUCTION SIGN FOR
USDA RURAL DEVELOPMENT PROJECTS



SIGN DIMENSIONS: 1200 mm x 2400 mm x 19 mm (approx. 4' x 8' x ¾")
PLYWOOD PANEL (APA RATED A-B GRADE–EXTERIOR)

SECTION 00710

GENERAL CONDITIONS

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 Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT FUNDING AGENCY EDITION

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

ACEC
American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN COUNCIL OF ENGINEERING COMPANIES

AMERICAN SOCIETY OF CIVIL ENGINEERS

This document has been approved and endorsed by

The Associated General Contractors of America

and the

Construction Specification Institute

Knowledge for Creating and Sustaining the Built Environment

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These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Funding Agency Edition No. C-521 (2002 Edition). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001, 2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800, 2002 Edition).

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GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. 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. *Agency* – The Federal or state agency named as such in the Agreement.

3. *Agreement* – The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

4. 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.

5. *Asbestos* – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

6. *Bid* – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

7. *Bidder* – The individual or entity who submits a Bid directly to Owner.

8. *Bidding Documents* – The Bidding Requirements and the proposed Contract Documents (including all Addenda).

9. *Bidding Requirements* – The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

10. *Change Order* – A document recommended by Engineer which is signed by Contractor and Owner and Agency and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

11. *Claim* – A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

12. *Contract* – The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

13. *Contract Documents* – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

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14. *Contract Price* – The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

15. *Contract Times* – The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

16. *Contractor* – The individual or entity with whom Owner has entered into the Agreement.

17. *Cost of the Work* – See Paragraph 11.01.A for definition.

18. *Drawings* – That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

19. *Effective Date of the Agreement* – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

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 which does not involve a change in the Contract Price or the Contract Times.

22. *General Requirements* – Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

23. *Hazardous Environmental Condition* – The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

24. *Hazardous Waste* – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

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

26. *Liens* – Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

27. *Milestone* – A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

28. *Notice of Award* – The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

29. *Notice to Proceed* – A written notice given 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 under the Contract Documents.

30. *Owner* – The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

31. *PCBs* – Polychlorinated biphenyls.

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32. *Petroleum* – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

33. *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.

34. *Project* – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

35. *Project Manual* – The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

36. *Radioactive Material* – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

37. *Related Entity* – An officer, director, partner, employee, agent, consultant, or subcontractor.

38. *Resident Project Representative* – The authorized representative of Engineer who may be assigned to the Site or any part thereof.

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

40. *Schedule of Submittals* – A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

41. *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.

42. *Shop Drawings* – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

43. *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 for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

44. *Specifications* – That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

45. *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 at the Site.

46. *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.

47. *Successful Bidder* – The Bidder submitting a responsive Bid to whom Owner makes an award.

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48. *Supplementary Conditions* – That part of the Contract Documents which amends or supplements these General Conditions.

49. *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 any Subcontractor.

50. *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 those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

51. Unit Price Work – Work to be paid for on the basis of unit prices.

52. *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, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

53. *Work Change Directive* – A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and Agency upon recommendation of the Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following 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 requirements of and information in the Contract Documents and conformance with the design concept of the completed 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 Paragraph 9.09 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.

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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 14.04 or 14.05).

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. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which 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. 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 Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *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 Agreement 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 Agreement.

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2.04 *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 the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule;

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.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, Agency, 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 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 *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 2.05.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 component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, 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. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage

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as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. *Standards, Specifications, Codes, Laws, and Regulations*

1. Reference to standards, specifications, manuals, 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, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement 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 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 Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of their Related Entities, 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 Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, 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 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

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 knew or reasonably should have known thereof.

B. Resolving Discrepancies

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

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

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3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3) or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier 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 Engineer's consultants, including electronic media editions; or

2. reuse any of 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 adaption by Engineer.

B. The prohibition 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.

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *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. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any,

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of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

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 the Work is to be performed 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.

4.02 *Subsurface and Physical Conditions*

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

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities 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.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed 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 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; 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 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb

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such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition 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 meet any one or more of the categories described in Paragraph 4.03.A; and

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 Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final 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

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

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous 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 shall not be responsible for the accuracy or completeness of any such information or data; 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 such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents,

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

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, 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 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *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 he 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.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities 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

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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 any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) 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.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. 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, either party may make a Claim therefor as provided in Paragraph 10.05.

F. 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. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, 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: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06. H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

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ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, 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 Documents. 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 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, 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 requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which 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:

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

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

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

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

   a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

   b. by any other person for any other reason;

5. 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; and

6. 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.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, 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;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

   a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, 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.

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5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (Contractor shall be responsible for any deductible or self-insured retention.). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss 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, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

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

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Contractor shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

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5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies 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 of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, 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 Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, 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 Contractor as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, 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 utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.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, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Contractor and made payable to Contractor as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Contractor shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof.

B. Contractor as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Contractor's exercise of this power. If such objection be made, Contractor as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Contractor as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Contractor as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of

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non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, 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. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *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. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

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. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 *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. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *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.

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B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, 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.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 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 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "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 specification or description 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 or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion 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, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, 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

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.

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2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The procedure requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. 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:

1) shall certify that the proposed substitute item will:

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

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

b) whether or not 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

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

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

b) available engineering, sales, maintenance, repair, and replacement services;

4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

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C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

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

E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the 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.

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

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. 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 any right of Owner or Engineer to reject defective Work.

C. 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. 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 anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

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E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. 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.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, 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 such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *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, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, 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 opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *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 knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear 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. However, it shall not be Contractor's primary responsibility to make certain

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that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 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 by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other 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 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 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 property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved

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Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. 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, 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 owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.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 (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or , 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).

D. Contractor's duties and responsibilities for safety and for protection of the Work 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 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *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.

6.15 *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.

6.16 *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

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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.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings*

a. Submit number of copies specified in the General Requirements.

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 6.17.D.

2. *Samples*

a. Submit number of Samples specified in the Specifications.

b. 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 6.17.D.

B. 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. *Submittal Procedures*

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

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

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

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

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

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 and approval of that 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 both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

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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 (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval 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 6.17.C.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's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

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.

6.18 *Continuing the Work*

A. 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, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *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 Related Entities shall be entitled to rely on representation of 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;

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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 or the issuance of a notice of acceptability by Engineer;

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

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 respective consultants, agents, officers, directors, partners, or employees 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 6.20.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 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, 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.

6.21 *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 law.

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, Shop Drawings 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.

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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 6.21, 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 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. 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 their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, 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.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

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

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

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

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

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8.09 *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.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *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 Documents and will not be changed without written consent of Owner and Engineer.

9.02 *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 9.09. 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.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. 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.

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9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which 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. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with 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, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. 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 Paragraph 10.05.

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

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

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D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents 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 14.07.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 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, subject to written approval by Agency at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *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 as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

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10.03 *Execution of Change Orders*

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

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. 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; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If notice 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) is required by the provisions of any bond to be given to a surety, 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.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

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E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

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 at the Site. 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, 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 11.01.

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

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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, 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 5.06.D), 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 telegrams, long distance telephone calls, telephone service at the Site, expressages, and similar petty cash items in connection with the Work.

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

B. *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 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which 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 Paragraphs 11.01.A and 11.01.B.

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C. Contractor's Fee: When all the Work 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 or when a Claim for an 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 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, 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.

11.02 *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

1. Contractor agrees that:

a. 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

b. 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*

1. 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.

11.03 *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. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

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.

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D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the Bid price of a particular item of Unit Price Work amounts to more than 5 percent of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and

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

3. Contractor believes that Contractor 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 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for 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, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. Contractor's Fee: 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 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.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 Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

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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 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, 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 Price or the Contract Times, or both. 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.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is 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 described in this Paragraph 12.03.B.

1. delays caused by or within the control of Contractor; or

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

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ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

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

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

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 and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. 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, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

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B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, 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, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, 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 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 Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. 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, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *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, 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.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. 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 removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *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 land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

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

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4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or 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. 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) will be paid by Contractor.

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 13.07, 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 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. 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) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *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 in accordance with Paragraph 13.06.A, 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, 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 13.09, 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, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, 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.

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C. 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) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. 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 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A 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.

14.02 *Progress Payments*

A. *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 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.

B. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, 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 on the Site 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;

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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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to 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 Documents; or

b. that 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 moneys 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 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

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

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

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D. *Reduction in Payment*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

   a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

   b. 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;

   c. the Contractor's performance or furnishing of the Work is inconsistent with funding Agency requirements;

   d. there are other items entitling Owner to a set-off against the amount recommended; or

   e. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action 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, when Contractor corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *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 (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

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

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D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

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. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and 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 14.04 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 5.10 regarding property insurance.

14.06 *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, Agency, and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *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, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

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2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

   d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible 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.

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 Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. 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 14.09. 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. *Payment Becomes Due*

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

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims. The remaining balance of any sum included in the final Application for Payment but held by OWNER for Work not fully completed and accepted will become due when the Work is fully completed and accepted.

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14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *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 notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will 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 established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),

2. 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

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.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 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) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by

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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.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. 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. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *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;

3. 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) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) 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 15.03.

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 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 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.

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ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Owner and Contractor may mutually request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process hall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *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 to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents 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.

17.03 *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 Documents. 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.

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17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

ARTICLE 18 – FEDERAL REQUIREMENTS

18.01 *Agency Not a Party*

A. This Contract is expected to be funded in part with funds provided by Agency. Neither Agency, nor any of its departments, entities, or employees is a party to this Contract.

18.02 *Contract Approval*

A. Owner and Contractor will furnish Owner's attorney such evidence as required so that Owner's attorney can complete and execute the following "Certificate of Owner's Attorney" (Exhibit GC-A) before Owner submits the executed Contract Documents to Agency for approval.

B. Concurrence by Agency in the award of the Contract is required before the Contract is effective.

18.03 *Conflict of Interest*

A. Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer.

B. Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in Contractor. Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

18.04 *Gratuities*

A. If Owner finds after a notice and hearing that Contractor, or any of Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner may, by written notice to Contractor, terminate this Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.

B. In the event this Contract is terminated as provided in paragraph 18.04.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an

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amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

18.05 *Audit and Access to Records*

A. For all negotiated contracts and negotiated modifications (except those of $10,000 or less), Owner, Agency, the Comptroller General, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the Contractor, which are pertinent to the Contract, for the purpose of making audits, examinations, excerpts and transcriptions. Contractor shall maintain all required records for three years after final payment is made and all other pending matters are closed.

18.06 *Small, Minority and Women's Businesses*

A. If Contractor intends to let any subcontracts for a portion of the work, Contractor shall take affirmative steps to assure that small, minority and women's businesses are used when possible as sources of supplies, equipment, construction, and services. Affirmative steps shall consist of: (1) including qualified small, minority and women's businesses on solicitation lists; (2) assuring that small, minority and women's businesses are solicited whenever they are potential sources; (3) dividing total requirements when economically feasible, into small tasks or quantities to permit maximum participation of small, minority, and women's businesses; (4) establishing delivery schedules, where the requirements of the work permit, which will encourage participation by small, minority and women's businesses; (5) using the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce; (6) requiring each party to a subcontract to take the affirmative steps of this section; and (7) Contractor is encouraged to procure goods and services from labor surplus area firms.

18.07 *Anti-Kickback*

A. Contractor shall comply with the Copeland Anti-Kickback Act (18 USC 874 and 40 USC 276c) as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States"). The Act provides that Contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. Owner shall report all suspected or reported violations to Agency.

18.08 *Clean Air and Pollution Control Acts*

A. If this Contract exceeds $100,000, Contractor shall comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 USC 7401 *et seq.*) and the Federal Water Pollution Control Act as amended (33 USC 1251 *et seq.*). Contractor will report violations to the Agency and the Regional Office of the EPA.

18.09 *State Energy Policy*

A. Contractor shall comply with the Energy Policy and Conservation Act (P.L. 94-163). Mandatory standards and policies relating to energy efficiency, contained in any applicable State Energy Conservation Plan, shall be utilized.

18.10 *Equal Opportunity Requirements*

A. If this Contract exceeds $10,000, Contractor shall comply with Executive Order 11246, "Equal Employment Opportunity," as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and as supplemented by regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

B. Contractor's compliance with Executive Order 11246 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative active obligations required by the Standard Federal Equal Employment

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Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4 and its efforts to meet the goals established for the geographical area where the Contract is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the Contract, and in each trade, and Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting Contractor's goals shall be a violation of the Contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

C. Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the Contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number; estimated dollar amount of subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the Contract is to be performed.

18.11 *Restrictions on Lobbying*

A. Contractor and each subcontractor shall comply with Restrictions on Lobbying (Public Law 101-121, Section 319) as supplemented by applicable Agency regulations. This Law applies to the recipients of contracts and subcontracts that exceed $100,000 at any tier under a Federal loan that exceeds $150,000 or a Federal grant that exceeds $100,000. If applicable, Contractor must complete a certification form on lobbying activities related to a specific Federal loan or grant that is a funding source for this Contract. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 USC 1352. Each tier shall disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Certifications and disclosures are forwarded from tier to tier up to the Owner. Necessary certification and disclosure forms shall be provided by Owner.

18.12 *Environmental Requirements*

A. When constructing a project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental constraints:

1. Wetlands – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.

2. Floodplains – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert 100 year floodplain areas delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, i.e., alluvial soils on NRCS Soil Survey Maps.

3. Historic Preservation – Any excavation by Contractor that uncovers an historical or archaeological artifact shall be immediately reported to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the State Historic Preservation Officer (SHPO).

4. Endangered Species – Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.

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EXHIBIT GC-A

Certificate of Owner's Attorney

I, the undersigned, _____, the duly authorized and acting legal representative of _____, do hereby certify as follows:

I have examined the attached Contract(s) and performance and payment bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements is adequate and has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with the terms, conditions, and provisions thereof.

_____

Date: _____

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Supplementary Conditions

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract Funding Agency Edition (No. C-710, 2002 Edition) and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated 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.

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SC-1.01.A.2. Add the following language to the end of Paragraph 1.01.A.2:

The Project is financed in whole or in part by USDA Rural Utilities Service pursuant to the Consolidated Farm and Rural Development Act (7 USC Section 1921 et seq.). The Rural Utilities Service programs are administered through the USDA Rural Development offices; therefore, the Agency for these documents is USDA Rural Development

SC-1.01.A.4. Add the following language to the end of Paragraph 1.01.A.4:

The Application for Payment form to be used on this Project is EJCDC No. C-620. The Agency must approve all Applications for Payment before payment is made.

SC-1.01.A.10. Add the following language to the end of Paragraph 1.01.A.10:

The Change Order form to be used on this Project is EJCDC No. C-941. Agency approval is required before Change

Orders are effective.

SC-2.03.A. Delete Paragraph 2.03.A in its entirety and insert the following in its place:

A. The Contract Times will commence to run 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 Agreement.

SC-4.02. Add the following new paragraphs immediately after Paragraph 4.02.B:

C. In the preparation of Drawings and Specifications, Engineer relied upon the following reports of exploration and tests of subsurface conditions at the Site:

1. Geotechnical Study, Interim Improvements Middle Fork Treatment Plant dated November 2009.

D. In the preparation of Drawings and Specifications, Engineer relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilitates) which are at or contiguous to the Site:

1. Survey; The Lane Group, Inc.

E. Copies of reports and drawings itemized in SC-4.02.C and SC-4.02.D that are not included with Bidding Documents may be examined at The Lane Group during regular business hours. These reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which the Contractor may rely as identified and established above are incorporated therein by reference. Contractor is not entitled to rely upon other information and data utilized by Engineer in the preparation of the Drawings and Specifications.

SC-4.06. Delete Paragraphs 4.06.A and 4.06.B in their entirety and insert the following:

A. No reports or drawings of Hazardous Environmental Conditions contiguous to the Site are known to the Owner or Engineer.

B. Not used.

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

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

SC-5.04. Add the following new paragraph immediately after Paragraph 5.04.B:

C. The limits of liability for insurance required by Paragraph 5.04 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 5.04.A.1 and A.2 of the General Conditions:

a. State: Statutory	
b. Applicable Federal (e.g., Longshoremen's)	Statutory
c. Employer's Liability	$ 5,000,000

2. Contractor's General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall

include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody, and control of the Contractor:

a.	General Aggregate	$2,000,000
b.	Products - Completed Operations Aggregate	$ 1,000,000
c.	Personal and Advertising Injury	$1,000,000
d.	Each Occurrence (Bodily Injury and Property Damage)	$1,000,000
e.	Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.	
f.	*Excess or Umbrella Liability*	
	1) General Aggregate	$2,000,000
	2) Each Occurrence	$1,000,000

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:

a.	Bodily Injury:	
	Each Person	$ 1,000,000
	Each Accident	$ 1,000,000
b.	Property Damage:	
	Each Accident	$ 1,000,000
c.	Combined Single Limit of	$ 1,000,000

4. The Contractual Liability coverage required by paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

a.	Bodily Injury:	
	Each Person	$ 2,000,000
	Each Accident	$ 2,000,000
b.	Property Damage:	
	Each Accident	$ 2,000,000
c.	Annual Aggregate	$ 2,000,000

SC-5.05. Delete paragraph GC-5.05 in its entirety and replace with the following:

"A. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.04, CONTRACTOR shall purchase and maintain for OWNER at CONTRACTOR's expense OWNER's Protective Liability insurance identifying OWNER as the named insured with ENGINEER and ENGINEER's Consultants as additional insureds. Said insurance will protect said parties against claims which may arise from operations under the Contract Documents. This coverage shall be written by the same company which provides CONTRACTOR's liability insurance coverage, and in the same minimum amounts."

SC-5.06. Clarification: The Contractor shall purchase and maintain property insurance in accordance with GC-5.06.

SC-6.05.C. Amend the paragraph by making two subparagraphs under the title C. Engineer's Evaluation. The paragraph text is retitled, 6.05.C.2 After Effective Date of Agreement. A new paragraph is added before this paragraph to read as follows:

1. During Bidding. The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, or "or-equal" materials and equipment as defined in paragraph 6.05 of the General Conditions, or those substitute materials and equipment approved by the Engineer and identified by Addendum. The materials and equipment described in the Bidding Documents establish a standard of required type, function, and quality to be met by any proposed substitute or "or-equal" item. Request for Engineer's clarification of materials and equipment considered "or-equal" prior to the Effective Date of the Agreement must be received by the Engineer at least 5 days prior to the date for receipt of Bids. No item of material or equipment will be considered by Engineer as a substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids. Each request shall conform to the requirements of Paragraph 6.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon the Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any proposed substitute item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner.

SC-6.06 Add a new paragraph immediately after Paragraph 6.06.G:

H. The Contractor shall not award work valued at more than fifty (50%) percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC-6.06.B. Add the following immediately after 6.06.B.:

No later than fourteen days after the execution of the Agreement by the CONTRACTOR and OWNER, the CONTRACTOR shall furnish the OWNER and the ENGINEER, in writing, with (1) the name, trade, and subcontract amount for each Subcontractor and (2) the names of all persons or entities proposed as manufacturers of the products identified in the specifications (including those who are to furnish the materials or equipment fabricated to a special design) and, where applicable, the name of the installing Subcontractor.

SC-10.06. Add the following new paragraph after paragraph 10.05:

10.06. Change Proposal Request:

A. When OWNER requests CONTRACTOR to present a proposal to accomplish a change in the Work, the request will be made in the form of a Change Proposal Request (CPR) prepared by ENGINEER. The CPR will describe the change and request CONTRACTOR to propose a cost and Contract Time change. CONTRACTOR will propose cost and time changes, provide a breakdown for the costs, sign the CPR, and return it to ENGINEER. ENGINEER will make recommendations to OWNER concerning acceptance. If the CPR is approved by OWNER, the CPR will be included in a Change Order. CONTRACTOR is not authorized to proceed with a change contained in a CPR until the Change Order is properly signed and issued.

B. When the CONTRACTOR desires to propose changes to the Work, it may initiate a CPR in the same form as provided in paragraph 10.06.A. and submit the CPR to the ENGINEER for the ENGINEER's review and recommendation.

SC-12.03.E Add the following new paragraph immediately after paragraph 12.03.E:

When establishing the contract time, an allowance will be made for four (4) calendar days of work lost per month due to inclement weather conditions. The Contractor, at the time of each periodic pay request, shall submit to the Engineer and Owner for approval a list of all working days lost due to either inclement weather or site conditions caused by inclement weather for the period. Accompanying his list should be a summary of the specific conditions which caused the loss. This request will be reviewed by the Engineer in light of observations made by the Engineer and resident inspector. Approval of the periodic payment estimate by the Engineer, Owner, and Agency will also include approval of the weather delay request. After substantial completion, and not until then, a change order must be executed if a time extension for weather related delays is requested by the Contractor. The time extension must be based solely on the time requested within the periodic payment estimates. Subtracted from this time will be the four (4) days per month allowance assumed in the contract. There cannot be a decrease in contract length if the allowance for inclement weather exceeds the actual number of days lost due to inclement weather. To convert working days into calendar days, multiply the working days by seven (7) and divide by the number of working days in a typical work week.

SC-14.02.A.3 Add the following language at the end of paragraph 14.02.A.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC-14.02.C.1. Delete Paragraph 14.02.C.1 in its entirety and insert the following in its place:

1. The Application for Payment with Engineer's recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 14.02.D will become due ten days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC-17.05 Add the following new paragraphs immediately after paragraph 17.05.A:

§ 2.2-4311. Employment discrimination by contractor prohibited; required contract provisions.

All public bodies shall include in every contract of more than $10,000 the following provisions:

1. During the performance of this contract, the contractor agrees as follows:

a. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

b. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer.

c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

2. The contractor will include the provisions of the foregoing paragraphs a, b and c in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

§ 2.2-4312. Drug-free workplace to be maintained by contractor; required contract provisions.

All public bodies shall include in every contract over $10,000 the following provisions:

During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

SC-18.02 Add the following new paragraph immediately after paragraph 18.02.B.:

C. During the performance of the Work under this Contract the Contractor must abide by the Labor Standards Provisions of the Davis-Bacon and Related Acts. The Contractor must comply with the minimum rates for wages for laborers and mechanics as determined by the Secretary of Labor in accordance with the provisions of the Davis-Bacon and Related Acts.

1. Wage Determination.

2. Labor Standards Provisions. The Labor Standards Provisions as stated in RD Instruction 1940-C, Exhibit A are hereby incorporated into this Contract. The Contractor will be responsible for complying with these provisions and the Owner and Agency will monitor compliance.

SC-18.02. Add a new paragraph immediately after Paragraph 18.02.C.

D. This Contract is funded in whole or in part using funds from the American Recovery and Reinvestment Act (ARRA). Section 1605 of the ARRA prohibits the use of these funds unless all iron, steel, and manufactured goods are produced in the United States. All iron and steel manufacturing processes must take place in the United States, except for metallurgical processes involving refinement of steel additives. There is no requirement for the origin of components and subcomponents of manufactured goods. Products listed at 48 CFR 25.104(a) have been determined to be unavailable in the United States and if required for the project may be purchased from foreign sources. No unauthorized use of foreign iron, steel, and/or manufactured goods will be allowed on this project.

SC-18.06 Add the following new paragraph immediately after paragraph 18.06.A.:

The goals and timetables for minority and female participation, expressed in percentage terms for the CONTRACTOR's aggregate work force in each trade on all construction work in the covered area are 0% for minorities and 6.9% for women.

SC-18.08 Delete paragraph 18.08.A in its entirety and insert the following in its place:

A. If this Contract exceeds $100,000, the Contractor shall comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act (42 USC §1857(h)), Section 508 of the Clean Water Act (33 USC §1368), Executive Order 11738, and Environmental Protection Agency regulations (40 CFR Part 15).

SECTION 01000

COORDINATION

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SECTION 01000

COORDINATION

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

A. Coordination of work and sequencing of construction with Owner's existing water treatment operations. Continuous water treatment operations meeting the satisfaction of the Owner shall be maintained at all times unless otherwise approved by Owner in writing.

B. Water treatment plant improvements including but not limited to:
   1. Coordination of construction with Owner and Engineer.
   2. Installation and maintenance of Erosion and Sediment Control Measures to meet the requirements of the Virginia Erosion and Sediment Control Handbook (current version).
   3. Site preparation and project construction.
   4. Utility service locations and tie-ins.
   5. Interface with existing water treatment operations.
   6. Materials testing.
   7. Equipment start-up and certification.
   8. Coordination with VDOT for work within their right-of-way.

C. Coordination of work and sequencing of construction with Owner's existing operations.

1.2 RELATED REQUIREMENTS

A. Related sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Sections in Division 2 through Division 16.

1.3 DESCRIPTION

A. Coordinate scheduling, submittals, and work specified to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating operation of existing water treatment facilities and the sequencing of work in accordance with the Completion Time presented in Paragraph 1.11 of this Section (01000).

1.4 MEETINGS

A. In addition to progress meetings specified in Section 01200 - *Project Meetings*, hold other coordination meetings and conferences with Owner, Engineer and subcontractors as required to assure coordination of all Work.

1.5 COORDINATION OF SUBMITTALS

A. Schedule and coordinate submittals specified in Section 01300 - *Submittals*.

B. Coordinate work of various Sections having interdependent responsibilities for completion, connecting to, and placing in service.

C. Owner and Owner's personnel will not operate or maintain any equipment for which approved Operations and Maintenance manuals are not delivered.

1.6 CONSTRUCTION TESTING SERVICES

A. Unless otherwise noted in the Contract Documents and Technical Specifications, quality assurance testing services will be provided by Owner at his expense.

B. Contractor's responsibilities:

1. Cooperate with testing laboratory personnel, and provide access to work.
2. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.
3. Provide incidental labor, materials and equipment to provide access to work to be tested, and to facilitate all required tests and inspections.
4. Notify Engineer twenty-four (24) hours prior to expected time for operations requiring inspection and testing services.
5. Pay all costs incurred by Owner for failed tests including the costs of retesting.

1.7 FIELD ENGINEERING

A. Verify existing conditions at the water treatment plant prior to starting Work. Promptly notify Engineer of any discrepancies.

1.8 LIMITS OF CONSTRUCTION

A. The Contractor shall restrict his operations to within the limits of construction as indicated on the drawings and shall comply with all OWNER, state, federal, and regulatory agency requirements related to operation of the existing water treatment facilities.

B. Existing roadways are not to be used for parking or other construction activities other than access to the construction areas unless authorized by Owner and/or Engineer. Owner will designate parking, staging and lay-down areas, in addition to those that may be shown on the Drawings.

C. Refer to Section 01060 - *Special Conditions* for other construction requirements.

1.9 DRAWINGS AND CONTRACT DOCUMENTS FOR CONTRACTOR USE

A. "No-Charge" Documents. Up to five sets of Drawings and Contract Documents shall be provided to Contractor at no charge.

B. Contractor shall pick up all "no-charge" documents within ten (10) days from date of Notice to Proceed.

C. Cost Documents. Additional documents in excess of the "No-Charge" documents will be furnished to Contractor for a fee, which is equal to the cost of reproduction and Engineer's 10% mark-up.

1.10 SCHEDULING AND COORDINATION

A. The Contractor shall issue a notice to the Washington County Service Authority at least five (5) business days prior to the start date requested to begin construction at the Facility. Submit to:

Washington County Service Authority
25122 Regal Drive
Abingdon, VA 24211
Attn: WCSA Technical Manager

1.11 COMPLETION OF CONSTRUCTION

A. Change in final completion schedule dates will not be a basis for allowing a change in Contract Price. If the work specified under this contract is amended by the Owner in accordance with the provisions of the Contract Documents as contained herein, said changes will be the sole basis for extending the final completion date of this contract.

B. Extension of Contract Times will be equal to the number of calendar days of such authorized delays, or additional work as it can be proven to impact the critical path of the project.

C. The Contractor will substantially complete all Work in accordance with the time frame and dates as defined in Agreement.

PART 2 – PRODUCTS - NOT USED.

PART 3 – EXECUTION - NOT USED.

END OF SECTION

SECTION 01020

ALLOWANCES

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SECTION 01020

ALLOWANCES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing handling and processing allowances.
   1. Selected materials and equipment, and in some cases, their installation are shown and specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. Additional requirements, if necessary, will be issued by Change Order.

B. Allowances:
   1. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents.
   2. Allowances shall cover the cost to Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts.
   3. Contractor's costs for unloading and handling materials and equipment at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances.
   4. Whenever costs are less than the allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect the difference between actual costs.

C. Types of allowances required include the following:
   1. Unit-cost allowances.
   2. Specified allowances.

D. After selection of the actual product to be used, a Change Order will be issued to add to or deduct from the Contract Amount any difference between the actual cost charged and the allowance.

E. Procedures for submitting and handling Change Orders are included in the General Conditions.

1.3 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.4 UNUSED MATERIALS

A. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 ALLOWANCES

A. Payment for Owner selected materials and equipment as specified in the Contract Documents will be made from designated allowances.
   1. Contractor's cost for installation of all Work specified by allowance items shall be included in Base Bid Price, the Base Bid Schedule in Section 00410 - *Bid Form*.
   2. The Contractor's overhead and profit and any subcontractor costs for Work specified by allowance items shall also be included in Bid Item No. 2 - *Middle Fork WTP Construction* the Base Bid Schedule in Section 00410 - *Bid Form*.

3.2 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Include the cost of $300.00 per thousand for face brick delivered to the site as specified in Section 04200 - Unit Masonry Work, and as indicated on the Drawings.

B. Allowance No. 2: Include the cost of $25.00 per square yard for carpet delivered to the site as specified in Section 09680 - Carpet, and as indicated on the Drawings.

C. Specified Allowances:
   1. Section 11227 - *Adsorption Clarifiers*.
   2. Section 15100 - *Miscellaneous Valves*, Parts 2.5 and 2.11.
   3. Section 16472 - *Variable Frequency Drives and Control Equipment*.
   4. Section 17701 - *Magnetic Flow Meters*.

END OF SECTION

SECTION 01026

MEASUREMENT AND PAYMENT

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SECTION 01026

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for unit prices.

B. Related Sections include, but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Divisions 2-16 - Technical Sections.

1.2 DESCRIPTION

A. Unit prices are as discussed in paragraph 11.03 of the General Conditions. Unit prices include all necessary mobilization, bonding, insurance, material, overhead, profit and applicable taxes.

PART 2 – PRODUCTS - NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 ROLE OF RESIDENT PROJECT REPRESENTATIVE

A. The Owner shall utilize a resident project representative for this work. Where actual quantities will differ by 5% or more from estimated quantities, Contractor shall notify the Representative and shall not proceed with work until the revised quantity is accepted.

B. Should, for whatever reason, the Representative be unavailable, the Contractor shall notify Owner to review and accept the revised quantity.

3.2 BID ITEM MEASUREMENT & PAYMENT DESCRIPTIONS

A. Bid Item No. 1 - Bonds, Mobilization and Insurance:
   1. Measurement: Bonds, Mobilization and Insurance shall consist of the performance of construction preparatory operations, including the movement of personnel and equipment to the project site, placement of project identification signs, payment of applicable fees and cost of insurance, payment of performance and payment bond and other insurance premiums and for the establishment of facilities necessary to begin work of the Contract.
   2. Payment: The line item shall be paid for at the contract lump sum price, which price shall be full compensation for performing the work specified and the furnishing of all materials, labor, tools, equipment and incidentals necessary to mobilize and subsequently demobilize the construction preparatory operations.
      a. Mobilization payments will not exceed 5% of the total bid.
      b. Partial payments shall be as follows:
         1) One-third of the amount established above as the total limit for partial payment, or one-third (1/3) of the amount bid for mobilization, whichever is less, will be released to the Contractor at the first estimate, payable not less than 15 days after the start of work at the project site.
         2) The second one-third (1/3) of the amount established above as the total limit for partial payment, or one-third (1/3) of the amount bid for mobilization, whichever is less, shall be released with the estimate payable 30 days after the first estimate.

3) The final one-third (1/3) of the amount established above as the total limit for partial payment, or one-third (1/3) of the amount bid for mobilization, whichever is less, shall be released with the estimate payable 30 days later than the estimate in which the second one-third (1/3) has been paid.

c. Upon completion of all work on the project, payment of any amount bid for mobilization/demobilization in excess of the total limit for partial payment will be released. Nothing herein shall be construed to limit or preclude partial payments otherwise provided for by the contract. No deductions will be made, nor will any increase be made, in the lump sum mobilization item amount regardless of decreases or increases in the final total contract amount or for any other cause.

B. Bid Item No. 2 - Middle Fork WTP Construction:

1. Measurement: Shall be based upon completion of all work associated with the construction of the Water Treatment Plant expansion and all other items shown on the Drawings to be constructed at the WTP site.
2. Payment: The line item shall be paid for at the contract lump sum price, which shall be full compensation for performing the work specified and the furnishing of all materials, labor, tools, equipment, and incidentals necessary to complete this bid item.

C. Bid Item No. 3 - Specified Allowances: Negotiated Major Equipment:

Measurement: Shall be based upon completion of all work associated with furnishing the items specified by allowance for the price indicated on the Bid Form. These amounts have been previously negotiated with the respective manufacturers/suppliers and reflect the binding amount submitted by those parties to the Owner for preparation of Shop Drawings/Submittals, fabrication, shipping, and start-up services. The contractor shall purchase the listed major equipment items for the negotiated sales prices listed in the bid form and any sales tax must be added to the Pay Item No. 2. Contractor shall be responsible for handling and installing the equipment at the site and for assisting the manufacturer's representative(s) in whatever ways are necessary to successfully start-up the equipment. Contractor's costs associated with Work required to successfully incorporate allowance items identified in this Pay Item No. 3 shall be included in Pay Item No. 2 and shall be as specified in Section 00410 - Bid Form and Section 00710 - General Conditions.

1. Payment: The line item shall be paid for at the contract lump sum price, which shall be full compensation for furnishing the equipment specified.

D. Bid Item No. 4 - Over Excavation and Backfill

1. Measurement: Shall be in cubic yards of unsuitable subgrade material removed as approved by the Engineer and calculated as follows:
   a. Measured in the field by the Engineer's on site representative using a vertical reference point 6" below the bottom of concrete slab vertically, and as recommended in the Geotechnical Study for horizontal extent from the foundation. In cases where the concrete slab is above existing grade, the over excavation quantity shall be measured vertically from the existing grade surface. Payment for excavation from existing grade to these reference locations shall be included in the lump sum price for the work and no separate payment will be made. Excavation in areas beyond the above reference locations for the contractor's convenience in access or for slope stability purposes will not be included in the Over Excavation quantity measurement. The over excavation quantity for unsuitable soil material from utility trenches shall be measured in the field by the Engineers on site representative. Measurement references for utility trench unsuitable materials over excavation shall be as noted on the plans.
2. Payment: The unit price bid for the bid item will be full compensation for all labor, materials, delivery costs, tools, equipment, supervision, surveying, warranty work, and incidentals necessary to remove unsuitable subgrade material and install suitable bearing material as described in the Geotechnical Study.

END OF SECTION

SECTION 01060

SPECIAL CONDITIONS

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SECTION 01060

SPECIAL CONDITIONS

PART 1 – GENERAL

1.1 PRECONSTRUCTION CONFERENCE

A. A mandatory preconstruction conference will be held after Award of Contract. See Section 01200 - *Project Meetings* for additional information.

1.2 TESTING

A. Payment for Soils, Concrete and Other Testing:
   1. Soils and Concrete testing: The Owner will pay for "Passing" soils tests on the Project. Owner will pay for "Passing" Field Concrete Tests and Concrete Cylinder Compressive Tests on the Project. Costs of corrective action and the costs of "Failing" Soils and Concrete Field Tests and retesting are the sole responsibility of the Contractor.
   2. Other Testing: Required testing, testing procedures, reports, certificates, and costs associated with all phases of securing required satisfactory test information which may be required by individual sections of Specifications or Drawings are the sole responsibility of the Contractor.

1.3 CONSTRUCTION SCHEDULE REQUIREMENTS

A. Construction operations will be scheduled to allow the Owner uninterrupted operation of the existing water treatment facilities. Coordinate construction and all connections with existing work to ensure timely completion of interfaced items, see the phasing plan in this section.

B. At no time shall Contractor or his employees modify operation of the existing water treatment facilities or start construction modifications without approval of the Owner except in emergency to prevent or minimize damage.

C. Within ten (10) days after award of Contract, submit for Engineer's and Owner's approval a critical path type schedule, "Work Schedule". Account for schedule of Subcontracts. Include proper sequence of construction, various crafts, purchasing time, shop drawing approval, material delivery, equipment fabrication, startup, pre-demonstration, demonstration, and similar time consuming factors including delays due to normally expected adverse weather. Show on schedule as a minimum, earliest starting, earliest completion, latest starting, latest finish, and free and total float for each task or item. Also submit planned plant downtime dates as detailed in this specification. Schedule should strongly consider continuing operations at the plant, including periods of high demand. Evaluate schedule not less than monthly. Update, correct, and rerun schedule and submit to Engineer in triplicate with pay application to show rescheduling necessary to reflect true job conditions. When shortening of various time intervals is necessary to correct for behind schedule conditions, indicate steps implemented and additional resources committed to accomplish work within schedule. Information shall be submitted to Engineer in writing with revised schedule.

D. If Contractor does not take necessary action to accomplish work according to schedule, Owner may order the Contractor in writing to take necessary and timely action to improve work progress. Order may require increased work forces, extra equipment, extra shifts or other action as necessary and shall be implemented and accomplished at no additional cost to the Owner. Should Contractor refuse or neglect to take such action authorized, under provisions of this contract, Owner may take necessary actions including, but not necessarily limited to, withholding of payment and termination of Contract.

E. Within ten (10) days after receipt of the approved "Work Schedule," submit to Engineer for approval, an estimated monthly payment and drawdown schedule. Include the estimated value of work complete and stored materials and specified retainage.

F. All work shall be completed in accordance with the "Contract Times" specified and defined in Section 00500 - *Agreement*.

G. The Phase I or Interim Improvements work is scheduled for final completion in late June 2011. The contractor performing this work will be onsite until that point, and to be performing any required warranty work for up to 1 year from that point. This contractor will be responsible for coordinating plant site activities, maintaining water treatment and access to plant facilities until the interim contract reaches substantial completion. At that time, or at Notice to Proceed for the 12 MGD Upgrade, the 12 MGD Upgrade Contractor shall be responsible for the plant site activities, maintaining water treatment and access to plant facilities.

1.4 ORDER OF CONSTRUCTION

A. Construction of all proposed work will be sequenced to allow the Owner to maintain continuous production of 6.6 MGD once the Interim Improvements are complete, and 4.6 MGD prior to that time. of finished water at the current capacity utilizing temporary and/or newly completed facilities and process components, except as detailed in the phasing plan and as authorized by the Owner. Any required reduction in flow rate shall be deemed a plant shut down.

B. Under any emergency condition or where a partial shutdown of existing facilities has been authorized by Owner, all modifications including utility connections and other required installation, start-up and testing work shall be pursued on a 24 hours per day seven days per week basis by the Contractor.

C. Contractor shall provide all temporary utilities, electrical connections, wiring, control, etc. as may be required.
   1. All materials shall be on the job and ready for installation for these items.

D. All arrangements, measurements, and planning shall be completed and approved in advance of taking existing facilities out of service.

E. Contractor shall submit to the Owner a detailed description of the procedure and schedule of work proposed. Procedure shall be reviewed and approved by Engineer and Owner prior to commencement of this Work.

F. Owner will cooperate in all reasonable ways to operate the facility in such a manner that Work may be carried out as expeditiously as possible, with the least amount of interference to the existing operation of the facility.

G. Owner shall have access to all operational facilities at all times, and provisions for the safety of all personnel according to all OSHA regulations shall be provided. Safe access to the plant building shall be maintained at all times.

1.5 CONSTRUCTION PHASING

A. The plant shall remain operational at full capacity at all times, except for brief durations, all less than 8 hours long, as detailed in this phasing plan. All plant shutdowns shall be coordinated with plant staff. Engineer, plant staff and Owner's Technical Manager will be notified in writing at least one week prior to any planned plant shutdown. All plant shutdowns will be conducted at night, after 8 pm, or at a time agreed to by the plant staff, owner and engineer. Any plant shutdowns will only be allowed in the months October through December and March through April. The schedule submitted to the Engineer required by this specification and the general notes shall include the plant shutdown times. Any changes to the proposed plant shutdown times will be noted in the monthly progress meetings and will require Owner and Engineer approval. The only plant shutdowns allowed will be for:
   1. Removal and reinstallation of the middle fork raw water venture.

B. Construction tasks shall include the addition of or upgrades/improvements to the following general systems:
   1. Middle Fork Raw Water Pump Station.
   2. Flocculators 4-6.
   3. Energy Recovery Building and Piping(Bid Alternate B).
   4. Intermediate Booster Pump Station.
   5. By-Pass Piping.
   6. Adsorption Clarifiers.
   7. Filters 5-8.
   8. Filters 1-4.
   9. Chlorine Contact Tank.
   10. Building improvements.
   11. Chemical Feed Building.
   12. Bulk Chemical Storage.

C. All construction activities shall be performed in such a manner that process water is not in danger of being contaminated with chemicals, debris, dust, paint or other contaminants. This includes damage from weather including freezing and contamination by wildlife, birds, etc. All open topped tanks downstream of the sedimentation basins shall be covered while in operation.
   1. Plant staff, the Engineers representative, or the Owner may halt construction activity if it is deemed that the process water is in danger of contamination.

D. During construction, it will become necessary to remove the large 48-inch and 36-inch above ground sedimentation effluent line from operation. In this situation, the Intermediate Booster Pump Station may be used to temporarily pump water to the operational filters.
   1. Prior to commencing this operation, ensure that shop drawings of all required equipment have been approved by the Engineer
   2. Flocculators 4-6 will be required to be operational prior to commencing this operation to ensure optimal treatment ability through the sedimentation basins.
   3. The ability to provide from 0.001 to 1 mg/L of non-ionic polymer at either the intermediate booster pumps suction, discharge or at each individual filter shall be provided in this temporary scenario. Duplex pumping equipment shall be provided. Polymer should be flow paced based upon the pumping rate from the intermediate booster pump station. The proposed polymer feed equipment to be finally provided in the plant building may be utilized for this purpose. It will have to be relocated after this temporary use.
   4. Provide the ability to adjust the pump station flow rate from the plant building for filter backwashing and flow adjustment.
   5. Test the treatment by pumping to one filter for a period of one week, adjusting dosage of the polymer, starting at 0.001 mg/L and adjusting upwards as required to reduce effluent filter turbidity and filter run times. Add additional filters one at a time as the operation proves successful.
   6. The 48-inch sedimentation basin line may be demolished once all four filters are being pumped to, have been backwashed at least twice and have operated in a satisfactory fashion for the course of one week. The pumped condition may not persist longer than 12 months.
   7. This phase of construction shall begin between March and April to minimize cold water conditions.
   8. The temporary piping shall be configured to allow the adsorption clarifiers to be brought into operation with no downtime (a valved connection to the temporary piping may be left in place).

1.6 PROJECT PROGRESS MEETINGS

A. The Engineer shall conduct construction progress meetings as stipulated in Section 01200 - Project Meetings.

1.7 RECORD DRAWINGS

A. The Contractor shall maintain a set of Plans and Specifications marked "Construction Record Drawings". The Contractor shall keep a complete and up-to-date record in red pencil of any and all changes made during construction and the exact location of all underground items. Underground items shall be measured from at least two permanent, easily identifiable above-ground reference points, with those dimensions reflected on the Record Drawings. This set of Record Drawings shall be submitted to and approved by the Engineer prior to final payment. The up-to-date Record Drawings shall be made available at each progress meeting. If it is determined that the Record Drawings are not current, partial payment may be delayed by Owner until Record Drawings are made current. The WCSA Technical Manager will utilize current Record Drawings to update the Owner's GIS, as construction proceeds.

1.8 DATA AND MEASUREMENTS

A. The data given in the Specifications and shown on the Plans and Drawings is believed to be accurate but the accuracy is not guaranteed. The Contractor must take all levels, locations, measurements, and verify all dimensions at each pump station site prior to construction and must adapt his work into the exact construction. Scale measurements taken from prints are not considered for more than reference, larger scale drawings take precedence over smaller scale, and shop drawings take precedence over all others.

1.9 REFERENCE POINTS

A. The Owner, in accordance with the General Conditions, will establish horizontal and vertical control points. Contractor shall preserve and protect all reference points and pay for replacement of any destroyed reference points.

1.10 CLEAN-UP REQUIREMENTS

A. Clean-up operations shall be conducted daily:
   1. Wastes shall not be buried or burned on site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the limits of construction and disposed of in a manner complying with local ordinances and anti-pollution laws.

B. See Section 01710 - *Cleaning*.

1.11 WARRANTY PERIOD

A. All Work, materials, products and equipment included under all phases of construction shall be guaranteed in accordance with requirements of the General Conditions for a period of one (1) year after the date when final payment becomes due.

1.12 SPECIAL CONSIDERATIONS

A. There will be a contractor on site constructing the Finished Water Pump Station, all required piping, a new filter and additions to the existing clearwell. Coordination with this contractor will be required for storage of materials, transportation, trailer locations, scheduling of plant downtimes among other items.

B. Contractor shall be responsible for any arrangements required to enable transportation of materials to the project site.

C. Maintain in good repair temporary structures, fences, barricades, and other related items.

D. Electric power:
   1. 120-VAC power required during construction will be provided from the existing facility electrical system(s). Contractor shall coordinate requirements and service location with Owner's Electrician. Any temporary lighting required for good and proper workmanship,

for inspection, or for safety shall be provided by the Contractor. Temporary lighting may be powered from existing building electrical system(s) as approved by Owner.

2. 480 volt power required during construction will be supplied by the Owner. The contractor shall be responsible to furnish and install all required wiring and electrical appurtenances and coordinate with the power company.
3. The contractor is required to coordinate temporary and final electrical power service with the power company. The OWNER will pay for costs from the power company for electrical service upgrades.

E. The Contractor alone shall be solely and completely responsible for conditions of the job site in connection with the Work, including safety of all persons and property, preparatory to and during performance of the Work. This requirement shall apply continuously and not be limited to normal working hours.

1. The Construction Documents, and the construction hereby contemplated are to be governed, at all times, by applicable provisions of local and State laws and regulations, and Federal laws, including but not limited to, the latest amendments of the following: Department of Labor, Bureau of Labor Standards Safety and Health Regulations for Construction, and Williams and Steiger Occupational Safety and Health Act (OSHA) of 1970, including rules and regulations pursuant thereto, applicable to the Work and performance of the Contract.
2. The duty of the Engineer to conduct construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

F. Authorized representatives and agencies of the State and Federal Government shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.

G. The Contractor shall make arrangements to provide fresh water for his drinking and normal use.

H. Some work will be performed within the VDOT right-of-way. This work may require a permit.

I. All work must be performed in a manner that will not jeopardize the continuous production of safe potable water and the monitoring of the tank system as established at the plant.

J. The OWNER will provide water for passing leak and pressure tests and for disinfection of newly constructed facilities. Water for failing leak and pressure tests shall be paid for by the Contractor at a rate of $1.30 per thousand gallons. During periods of high demand, water may not be available for testing, coordinate with the Owner's Technical Manager for provision of testing and disinfection water.

1.13 PROJECT VIDEO TAPING

A. Prior to initiating any work on the site, the Contractor shall video tape the proposed project site across the entire limits of construction. The Contractor shall provide two or DVD copies of the video to the Engineer prior to initiating work. The video shall clearly show all surface objects (building, tanks, pavement, manholes, light poles, trees, shrubs, etc.) within the project site. Special attention shall be paid to all structures, and a minimum of 8 minutes of video shall be taken for each of the following: exterior of the pump station; each interior room in the plant building and sedimentation basins. Include at least two minutes of footage for each interior room in the plant building. Taping should include at least two different angles and care shall be taken to ensure adequate lighting is available for all segments of the recording.

1.14 SALVAGE ITEMS

A. The piping and equipment onsite shall be demolished as indicated in the contract document. The Owner reserves the right to retain any item demolished.

B. The Contractor shall return to the Owner in good condition the following items, at minimum:
1. Fluoride Analyzer
2. Polymer Feed Unit
3. Carbon Equipment
4. Chlorine Gas Monitoring Equipment
5. Chlorine one-ton scales
6. Chlorinators
7. Filter Consoles
8. Clear Well Ultrasonic
9. Current Coagulant Pump, Fluoride Pump and Caustic Pump
10. Current Coagulant Tank

C. The coagulant tank shall be delivered to the Owner's onsite storehouse.

1.15 CONTRACTOR'S FIELD OFFICE

A. Establish at site of Project.

B. Field Office Equipment: Telephone, telephone facsimile, computer with email account and internet access, mailing address, and sanitary facilities.

C. Assure attendance at this office during the normal working day.

D. At this office, maintain complete field file of shop drawings, posted Contract Drawings and Specifications, and other files of field operations including provisions for maintaining "Record Drawings".

E. Remove field office from site upon acceptance of the entire work by the Owner.

F. Provide field office for owner's representative, including:
1. Separate entrance and wall separation from contractor's office.
2. One desk 36 x 72 IN long with locking lap drawer.
3. One plan table 39 x 72 x 36 IN.
4. Two four-drawer filing cabinets.
5. Two cushioned swivel arm chairs.
6. Two conference chairs.
7. One bookcase, composed of three shelves 36 IN long and 12 IN wide. The units shall be a minimum of 3 FT high.
8. One standard size waste paper basket.
9. One Emerson Model OR300A, 2.7 CF refrigerator or equal.
10. One copying machine with self-feed document scanner and faxing ability: Brother MFC-8220 or equal.
11. Wireless high speed internet access.
12. Vertical drawing rack with space for 12 clamps, each capable of holding 50 sheets
13. Phone line with cordless phone.

PART 2 – PRODUCTS - NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 SUGGESTED CONSTRUCTION SEQUENCING PLANS

A. These suggested sequencing plans are not intended to serve as the required order of construction, but are only included as an aid to the Contractor during the bidding phase. The successful Contractor shall be required to develop their own detailed sequence of construction that allows for parallel construction activities, and accounts for seasonal water treatment variables.

B. Suggested Sequence:

1. Prior to any demolition work, construct the Intermediate Booster Pump Station.
2. Construct the 24-inch force main as close to future plant building as possible. Provide valved 24x18 inch tee for connection to allow final connection to adsorption clarifiers without downtime. Extend temporary 18-inch piping from the end of the 24-inch piping to the filter influent troughs of existing filters 1-4. Connect temporary 18-inch header to existing 12-inch and 14-inch valves with open/close actuators. It may be necessary to adjust the actuator open/close points to balance flows to each of the four filters.
3. Construct 20-inch middle fork raw water line around existing building, relocate venturi within the plant building
4. Build bulk chemical feed facility and either:
   a. Place existing or new coagulant metering pumps in bulk facility in temporary and protected conditions,
   b. Construct chemical feed building with a priority of installing coagulant feed facilities.
   c. Construct temporary pumped force main from the bulk facility to serve the existing coagulant day tank in the basement of the plant building. Manual operation of the bulk pump at the day tank will be required.
5. Build new flocculators, with chemical feed facilities. If Bid Alternate B is accepted, portions of the Energy Recovery Building should be constructed at this time.
6. Put Intermediate Booster Pump station in operation as described in this section with polymer feed and provisions for flow rate adjustment installed in the plant building.
7. Demolish all above ground piping, abandoned sedimentation basins, coagulant tank, plant building front porch.
8. Build:
   a. Filters 5-8, with temporary backwash piping as shown on drawings.
   b. Adsorption clarifiers 1-3.
   c. Filter influent channels.
   d. Chlorine contact tank addition and chlorine contact tank 2 and chlorine contact connector channel.
   e. Polymer and Fluoride feed system.
   f. Laboratory and Bacteriological Laboratory.
   g. Roof over all of the above (temporary sheathing may be required between new and old portions of the building).
9. Relocate and install blowers, one at a time leaving one in service at all times.
10. Test all tanks for water tightness.
11. Establish temporary control center for all operational facilities in a suitable location, preferably the existing control room.
12. Bring adsorption clarifiers, filters 5-8 and chlorine contact tank 2 into service.
13. The following general systems may be constructed at any time:
    a. Energy Recovery Building (Bid Alternate B).
    b. Middle Fork Raw Water Improvements (Bid Alternate A).
    c. Chemical Feed Building (though coagulant must be fed continuously).

END OF SECTION

SECTION 01062

MAJOR EQUIPMENT AND SYSTEMS SUPPLIERS

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SECTION 01062

MAJOR EQUIPMENT AND SYSTEMS SUPPLIERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. A listing of the equipment and systems for the Project, which is considered to be major equipment or systems.
   2. A listing of the approved suppliers of said major equipment and systems.
   3. Certain instructions concerning the bidding of major equipment and systems.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 DEFINITIONS

A. Manufacturers or suppliers, as used in the context of "approved manufacturers or suppliers of major equipment and systems," shall mean the manufacturers or suppliers listed in Article 1.4 of this Section (01062).

1.3 INSTRUCTIONS FOR BIDDING MAJOR EQUIPMENT AND SYSTEMS

A. Furnish, for base bid, equipment and systems by any of the suppliers listed in Article 1.4 ACCEPTABLE MANUFACTURERS OF MAJOR EQUIPMENT of this Section, or as added to Article 1.4 by addendum.

B. Name only one of said manufacturers in "Schedule of Proposed Equipment Suppliers" of the Bid Form (Section 00300).

C. Proposal shall be considered irregular and subject to rejection if the Bidder:
   1. Fails to list an approved supplier for each item.
   2. Lists more than one approved supplier for each item.

D. If the Bidder fails to list an approved supplier, the Owner has the sole right to select one of the suppliers from the list of acceptable Manufacturers of Major Equipment in Article 1.4.

E. If the Bidder lists more than one approved supplier, the Owner has the sole right to select one of the suppliers so listed.

F. Requests for prequalification of equipment and systems to be listed in Article 1.4 must comply specifically with applicable provisions of the Contract Documents. Refer to Section 00100 - Instructions to Bidders.

G. The listing of a manufacturer or supplier of Major Equipment as an acceptable or approved manufacturer under Article 1.4 of this Section (01062) by Engineer does not alleviate that manufacturer or supplier from the responsibility to provide equipment and systems in full compliance with all technical requirements and provisions specified under the Contract Documents, drawings and individual specification sections for the equipment or systems supplied.

H. Failure to provide major equipment or systems in full compliance (as determined by Engineer) with these documents shall result in the Bidder's Proposal being considered irregular and subject to rejection regardless of the prequalification status of manufacturer or supplier.

I. In the event that the Engineer determines for any reason that an item of equipment or system to be supplied under the provisions of this Section by an approved Major Equipment manufacturer or supplier is not in full compliance with the Contract Documents, drawings and technical specifications, the Owner shall have the sole right to reject said equipment and select another manufacturer or supplier from the list of acceptable Manufacturer's of Major Equipment in Article 1.4 to provide proposed equipment or system at no additional cost to Owner or change in Bidder's total Base Bid Price.

1.4 ACCEPTABLE MANUFACTURERS OF MAJOR EQUIPMENT AND SYSTEMS

A. Major Equipment and Acceptable System Manufacturers:

1. Filter Units (Section 11025):
   a. Infilco Degremont, Inc.
   b. The F.B. Leopold Company Inc.
   c. Roberts Water Technologies, Inc.
   d. Or approved equal.
2. Pumping Equipment: Submersible Chopped Type (Add Alternate A2) (Section 11070):
   a. Vaughn Co., Inc.
   b. Haywood Gordon, Inc.
   c. Or approved equal.
3. Pumping Equipment: Vertical Turbine (Section 11072):
   a. Fairbanks-Morse.
   b. Peerless.
   c. Goulds.
   d. Or approved equal.
4. Mixing Equipment - Submersible (Add Alternate A2) (Section 11152):
   a. Wilco EMU.
   b. Landin.
   c. ITT Flyght.
   d. Or approved equal.
5. Chemical Metering Pumps (Peristaltic) (Section 11240):
   a. Watson-Marlow/Bredel.
   b. Verdeflex Pumps.
   c. Or approved equal.
6. Chemical Feed Bulk Transfer Systems (Section 11927):
   a. Pulsafeeder
   b. Goulds
7. Powdered Activated Carbon (PAC) Dry Chemical Feeder (Section 11880):
   a. Siemens.
   b. Acrison.
   c. Merrick.
   d. Or approved equal.
8. Chlorine Vapor Scrubber System (Add Alternate A1) (Section 11930):
   a. Purafil, Inc.
   b. Severn Trent.
   c. Or approved equal.
9. Flocculation Basin Mixers (Base Bid & Alternate A4) (Section 11948):
   a. Sharpe Mixers.
   b. Lighting Mixing Equipment Co.
   c. Philadelphia Mixer Corp.
   d. Chemineer, Incorporated.
   e. Or approved equal.
10. In-Line Static Mixers (Section 11999):
    a. Komax System, Inc.
    b. Chemineer, Incorporated.
    c. Koflow Corporation.
    d. Southeastern Fiberglass.
    e. Or approved equal.

11. Fiberglass Reinforced Plastic Tank (Base Bid & Alternate A3) (Section 13200):
    a. Augusta Fiberglass.
    b. Plas-Tanks Industries.
    c. Advance Fiberglass, Inc.
    d. Diamond Fiberglass.
    e. Or approved equal.
12. Control & Information System Scope & General Requirements (System Integrators) (Section 17000):
    a. Sherwood-Logan.
    b. Systems East.
    c. American Mine Research.
    d. Piedmont Automation.
    e. Or approved equal.

1.5 PREQUALIFICATION PROCEDURE FOR MAJOR EQUIPMENT AND SYSTEMS

A. Major equipment and systems as described in Paragraph 1.4 of this Section (01062) establish a standard of required type, function and quality to be met by any proposed "substitute" submitted for prequalification approval.

B. No item of equipment will be considered by ENGINEER as a prequalified major equipment or system substitute unless written request for approval has been submitted by an interested party and has been received by ENGINEER at least fifteen (15) days prior to the date for receipt of Bids. Requests received after this date will not be considered.

C. An interested party requesting ENGINEER's approval and prequalification of a substitution for an item of major equipment or system shall prepare a request for prequalification. The submittal shall identify the interested party and the item for which the request for prequalification is being made, and shall include data as specified in Paragraph D of this Article (1.5).

D. The following data must be included in the request for prequalification. Failure to submit complete information requested below will result in the submittal being declared non-responsive and the equipment being rejected.
    1. Submittal shall include a letter stating proposed equipment or system will perform the same function, is of comparable quality, substance, design and efficiency, and will fit in the space limitations of the structure. Letter shall be on manufacturer's letterhead and signed by an authorized representative of the manufacturer.
    2. Attach to the letter a matching outline of the "PART 2 - PRODUCTS" portion of the applicable specification section (2.1, 2.1-A., 2.1-A.1., etc.). If the proposed equipment fully meets the information contained in that paragraph, said paragraph shall be labeled "Full Compliance." If deviations exist, each deviation shall be discussed in full including complete definition of deviation, full technical justification of deviation, and cost impacts of the deviation.
    3. Name, address and telephone number of nearest manufacturer's sales and service representative.
    4. All data necessary to evaluate the equipment for the intended installation. General catalog cuts and specifications shall be edited by the manufacturer so as to be representative of equipment specifically applicable to the Project.
    5. List of similar operating installations using equipment similar in size and function. Include with each installation:
        a. Name and telephone number of contact.
        b. Name and telephone number of design engineer firm and Contact person.
        c. Date of equipment startup.

E. Send the request for prequalification to:

Olver Incorporated
1116 South Main Street
Blacksburg, VA 24060
Telephone: (540) 552-5548
Attn: Eric T. Anderson, P.E.

F. Identify contents on outside envelope with the following inscription:

"Washington County Service Authority - Middle Fork WTP Upgrade to 12 MGD"

G. The burden of proof of the merit of the proposed item is upon the interested party making the submittal. ENGINEER's decision of approval or disapproval of a proposed item will be final.

H. If ENGINEER approves the request for prequalification, ENGINEER will include the approved substitution in the Contract Documents as an approved manufacturer of major equipment and will notify all BIDDERS by Addendum. BIDDERS shall not rely upon approvals made in any other way.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

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SECTION 01200

PROJECT MEETINGS

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

A. Contractor participation in preconstruction conference.

B. Contractor participation in monthly progress meetings and problem or work deficiency meetings.

1.2 RELATED REQUIREMENTS

A. Related sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.3 PRECONSTRUCTION CONFERENCE

A. Attendance: Owner, Engineer, Contractor Project Manager and Superintendent, Systems Integrator, and any Major Subcontractor representatives.

B. Engineer will schedule conference within fourteen (14) days after Notice of Award, and will notify the attendees at least one week in advance of the proposed date.

C. Agenda:
   1. Submittal of executed bonds and insurance certificates.
   2. Execution of Owner-Contractor Agreement.
   3. Distribution of Contract Documents.
   4. Submittal of list of Subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of responsible personnel.
   6. Procedures and processing of field decisions, corresponding submittals, substitutions, applications for payments, proposal requests, change orders, and Contract procedures.
   7. Scheduling.
   8. Coordination with plant staff.
   9. Other topics of concern.

1.4 PROGRESS MEETINGS

A. Attendance: Project Superintendent, major Subcontractors, Owner, and Engineer.

B. Engineer will schedule and administer project meetings monthly or as requested by Owner. Meetings will be scheduled to most conveniently accommodate all attendees.

C. Engineer will make physical arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies to participants and those affected by decisions made at meetings.

D. Suggested agenda: Review of work progress, status of progress schedule and adjustments thereto, delivery schedules, submittals, progress monitoring, standards, pending changes and substitutions, scheduled work coordination between Contractor's and Owner's on-site activities, and other items affecting progress of work.

E. Contractor must bring updated schedule and most recent set of Record Drawings to these meeting for Engineer review.

PART 2 – PRODUCTS - NOT USED.

PART 3 – EXECUTION - NOT USED.

END OF SECTION

SECTION 01300

SUBMITTALS

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SECTION 01300

SUBMITTALS

PART 1 – GENERAL

1.1 SUMMARY

A. General:
   1. Section Addresses:
      a. Procedures and administration of the submittal process for shop drawings, operation and maintenance manuals, instrumentation diagrams and miscellaneous submittal items.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   4. Sections in Division 2 through Division 16 identifying required submittals.

1.2 DEFINITIONS

A. Submittals include but are not necessarily limited to:
   1. Shop Drawings.
   2. Construction Schedule.
   3. As-Built Survey Data and Record Drawings.
   4. Testing Reports.
   5. Product Certifications and Warranties.
   6. Schedule of Values for Payment Applications.
   7. Required forms included in Section 00600 - SUPPLEMENTAL BID / CONTRACT FORMS.

1.3 PROCEDURES

A. Deliver submittals to Engineer:

The Lane Group, Inc.
124 Depot Avenue
Chilhowie, Virginia 24319
Attn: Jeff Spickard, P.E.

B. Transmit each item under Engineer-acceptable form. Identify Project Name, Engineer's Contract Number, Contractor, Subcontractor, major supplier; identify pertinent drawing sheet and detail number, and specification section number, as appropriate. Identify deviations from Contract Documents. Provide space for Contractor and Engineer review stamps.

C. Submit initial progress schedules and schedule of values in duplicate within fourteen (14) days after date established in Notice to Proceed. After review by Engineer, revise and resubmit as required. Submit revised schedules with each Application for Payment, reflecting changes since previous submittal.

D. Comply with progress schedule for submittals related to work progress. Coordinate submittal of related items.

E. After Engineer review of submittal, revise and resubmit as required, identifying changes made since previous submittal.

F. Distribute copies of reviewed submittals to subcontractors, Engineer, and other concerned parties. Instruct recipients to promptly report any inability to comply with any instructions or provisions.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit Construction Schedule as specified in Section 01060 - Special Conditions. Schedule shall be in the form of a computerized Critical Path Method (CPM) Chart or Bar Chart.

B. Submit projected percentage of completion for each item of work at the time of each Application for Progress Payment, and actual attained percentage of completion.

1.5 SCHEDULE OF VALUES

A. Submit typed schedule on form similar in function to "Schedule of Values Form". Contractor's standard form or media-driven printout will be considered on request.

B. Revise schedule to list Change Orders, if applicable, for each Application for Payment. Change Orders shall be listed separately from the Base Bid Work.

1.6 SHOP DRAWINGS

A. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Approve all submittals and shop drawings prior to submitting to Engineer.

B. Determine and verify:
1. Field measurements.
2. Field construction criteria.
3. Catalog numbers and similar data.
4. Conformance to Specifications.

C. Coordinate each submittal with other submittals and with requirements of work and of Plans and Specifications.

D. Notify Engineer in writing, at time of submission, of any variation in submittals from requirements of Plans and Specifications. Deviations permitted by Engineer may require modifications of Plans and Specifications by approved Change Order.

E. Submittals:
1. Transmit under Contractor's standard letter of transmittal or letterhead.
2. Submit as specified in individual specification section and Section 01340 - Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.

1.8 ENGINEER DUTIES

A. Review required submittals with reasonable promptness and in accordance with schedule, only for general conformance to design concept of project and compliance with information given in Plans and Specifications. Review shall not extend to means, methods, sequences, techniques, or procedures of construction or to safety precautions or programs incidental thereof. Review of a separate item as such will not indicate approval of assembly in which item functions.

B. Affix stamp and initials or signature, and indicate requirements for resubmittal, or review of submittal. Engineer's Review Action on submittals is specified in Section 01340 - *Shop*

Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneaus Submittals.

C. Return "Rejected" or "Revise and Resubmit" Submittals to Contractor. Distribute "Furnish as Submitted" and "Furnish as Noted" Submittals to Contractor, Owner, and Field Representative.

D. Engineer's review of submittals shall not relieve Contractor from responsibility for any deviations from Plans and Specifications unless Contractor has, in writing, called Engineer's attention to such deviation at time of submission, and Engineer has given written concurrence pursuant to Plans and Specifications to specific deviations, nor shall any concurrence by Engineer relieve Contractor from responsibility for errors or omissions in submittals.

E. Installation, manufacture or fabrication of items prior to final approval is at Contractor's own risk.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When required in individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and operation, in quantities specified for product data.

PART 2 – PRODUCTS - NOT USED.

PART 3 – EXECUTION - NOT USED.

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA & SAMPLES; OPERATIONS AND MAINTENANCE MANUALS; AND MISCELLANEOUS SUBMITTALS

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SECTION 01340

SHOP DRAWINGS, PRODUCT DATA & SAMPLES; OPERATIONS AND MAINTENANCE MANUALS; AND MISCELLANEOUS SUBMITTALS

PART 1 – GENERAL

1.1 SUMMARY

A. General:
   1. Section Addresses:
      a. Procedures and administration of the submittal process for shop drawings, operation and maintenance manuals, training materials, and miscellaneous submittal items.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Sections in Division 2 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. Miscellaneous Submittals:
   1. Submittals other than Shop Drawings:
   2. Representative types of miscellaneous submittal items include but are not limited to:
      a. Construction schedule.
      b. Installed equipment and systems performance test reports.
      c. Manufacturer's installation certification letters.
      d. Instrumentation and control wiring diagrams.
      e. Warranties.
      f. Service agreements.
      g. Construction photographs.
      h. Survey data.
      i. Cost breakdown (Schedule of Values).

1.3 TRANSMITTALS

A. Shop Drawings and Operation and Maintenance Manuals:
   1. Transmit all submittals to:

The Lane Group, Inc.
124 Depot Avenue
Chilhowie, Virginia 24319
Attn: Jeff Spickard, P.E.

   2. All transmittals must be from Contractor and bear his approval stamp. Transmittals will not be received from or returned directly to subcontractors.
      a. Shop drawing transmittal stamp shall state "(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 6.17.D. Transmittals will not be received from or returned directly to subcontractors.
      b. Operation and Maintenance Manual transmittal stamp may be Contractor's standard approval stamp.

3. Provide submittal information defining specific equipment or materials utilized on the project. Generalized product information not clearly defining specific equipment or materials to be provided will be rejected.
4. Calculations required in individual specification sections will be received for information purposes only and will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
5. Submittal Schedule:
   a. Schedule of shop drawings:
      1) Submitted and approved within 20 days of receipt of Notice to Proceed.
   b. Shop drawings:
      1) Submittal and approval prior to 50 percent completion.
   c. Operation and Maintenance Manuals and Equipment Record Sheets:
      1) Initial submittal within 30 days after date shop drawings are approved.

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:

The Lane Group, Inc.
124 Depot Avenue
Chilhowie, Virginia 24319
Attn: Jeff Spickard, P.E.

1.4 PREPARATION OF SUBMITTALS

A. Shop Drawings:
1. Number transmittals consecutively beginning with 1.
2. Number transmittals of resubmitted items with the original root number and a suffix letter starting with "A" on a new transmittal form.
3. Restrict each Letter of Transmittal to only one Specification Section or portion thereof.
4. Provide breakout of each transmittal contents on transmittal form. Each component thus defined will receive specific action by the Engineer. Define manufacturer, item, Contract Document tag number, and Contract Drawing/Specification reference.
5. Do not change the scope of any resubmittal from the original transmittal scope. If some components of the original or previous resubmittal transmittal received "A" or "B" Action and others did not, list the "A" or "B" Action components in subsequent resubmittal packages and indicate "A" or "B" Action code previously received on the transmittal form. With prior approval of the Engineer, components of an original submittal or prior resubmittal that have not received an "A" or "B" Action may be withheld from a resubmittal. Such components shall be listed on the resubmittal transmittal form and indicated as "Outstanding - To Be Resubmitted At a Later Date."
6. Provide four copies of each page for Engineer plus the number the Contractor desires to have returned. The number of copies the Contractor desires to have returned will be defined at the Preconstruction Conference, but shall not exceed six (6).
7. Provide clear space (3 IN SQ) for Engineer stamping of each component defined in paragraph 1.06-A.1.
8. Contractor shall not use red color for marks on transmittals. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
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 like equipment brochures, cuts of fixtures, product data sheets or catalog sheets on 8½ IN x 11 IN pages. Indicate exact item or model and all options proposed.

e. Include legible scale details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout drawings, parts catalogs, rough-in diagrams, diagrams, controls, weights, and other pertinent data. Arrange data and performance information in format similar to that provided in Contract Documents. Provide, at minimum, the detail provided 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.

B. Samples:

1. Identification:
   a. Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, specification section or drawing detail reference, color, range, texture, finish and other pertinent data. 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.
2. Include application specific brochures, and installation instructions.
3. 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.
4. Resubmit samples of rejected items.

C. Training Materials:

1. Typed agenda for training session, as well as all handouts to be provided.

1.5 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.
   c. C - REVISE AND RESUBMIT.
   d. D - REJECTED.
   e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Transmittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp. Drawings not stamped by the Contractor or stamped with a stamp containing language other than that specified in Paragraph 1.03-A.4., will not be reviewed for technical content and will be returned without any action.
3. Transmittals returned with Action "A" or "B" are considered ready for fabrication and installation. If for any reason a transmittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter identifying why the submittal previously marked "A" or "B" is to be superseded by the resubmittal.
4. Transmittals 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 transmittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference). All but one copy (for Engineer's File) of the "C" or "D" submittal will be marked up and returned to the Contractor. 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. This is at the sole discretion of the Engineer. In this case, some drawings may contain relatively few or no comments or

the statement, "Resubmit to maintain a complete package." Distribution to the Owner and field will not be made (unless previously agreed to otherwise).

5. Failure to include any specific information specified under the submittal paragraphs of the specifications will result in the transmittal being returned to the Contractor with "C" or "D" Action.
6. In addition to calculations stamped and returned "E. Engineer's Review Not Required," other transmittals such as 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 transmittal, will be returned with Action "E. Engineer's Review Not Required."
7. Samples may be retained for comparison purposes. Remove samples when directed. Include in bid all costs of furnishing and removing samples.
8. Approved samples submitted or constructed, constitute criteria for judging completed work. 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 - FURNISH AS SUBMITTED.
   b. B - FURNISH AS NOTED.
   c. C - REVISE AND RESUBMIT.
   d. D - REJECTED.
   e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Acceptable submittals will be retained and with the transmittal form returned with a request for three (3) additional copies and electronic copy.
3. Deficient submittals will be returned along with the transmittal form which will be marked to indicate deficient areas.
4. Provide two digital copies of the final approved O&M manual on a CD or DVD for Owner's use.

PART 2 — PRODUCTS - NOT USED.

PART 3 — EXECUTION - NOT USED.

END OF SECTION

SECTION 01600

PRODUCT DELIVERY, STORAGE, AND HANDLING

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

C. Payment:
   1. No payment will be made to Contractor for equipment or materials not properly stored per manufacturer's recommendation 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.

D. Contractor shall make all arrangements and pay any costs associated with transportation, handling and storage of equipment.

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.

1.3 STORAGE AND HANDLING

A. General:
   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. Prior to shipment of equipment to the project site, store electrical equipment and other equipment having antifriction or sleeve bearings in weather-tight warehouses that are maintained at a minimum temperature of at least 40°F until installation.

PART 2 – PRODUCTS - NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

A. Inspect Deliveries:
   1. Inspect all products or equipment delivered to the site prior to unloading. Reject any products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

B. Monitor Storage Areas:
   1. Monitor storage areas to ensure suitable conditions are maintained.

C. Confine all operations of the Contractor (including storage of materials, supplies and equipment) to areas authorized by the Owner. The Contractor shall be liable for any and all damages caused by him to such premises.

D. Stored materials, supplies or equipment shall be carefully and continuously protected from damage or deterioration and be located so as to facilitate inspection by the Owner and the Engineer. The responsibility for the care and storage of materials, supplies, or equipment shall be the Contractor's unless otherwise noted. Storage of materials, supplies or equipment shall not unduly interfere with the progress of the Contractor's Work or the work of any other contractor. The Contractor shall construct temporary storage units to protect stored materials on site or provide off site storage in a controlled space.

END OF SECTION

SECTION 01640

PRODUCT SUBSTITUTIONS

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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.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of The Contract.
   2. Division 1 - General Requirements.
   3. Section 01062 - *Major Equipment and System Suppliers*.

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.

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 GENERAL SUBSTITUTION

A. The procedures for general substitution outlined under this Article (1.4) are applicable to all Contractor supplied equipment, products and other materials of construction as shown on the Drawings and specified in these Contract Documents with exception of substitutions for major equipment items as defined under Section 01062 - *Major Equipment and Systems Suppliers*. Substitution or prequalification procedures for major equipment and systems are defined in accordance with Section 01062 - *Major Equipment and Systems Suppliers*.

B. General substitution requests will be considered, only after award of Contract.

C. Proposed substitutions must be presented in the form of written requests submitted through Contractor only.

D. Transmittal Mechanics:

1. Follow the transmittal mechanics prescribed for shop drawings in Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals*. Product substitution will be treated in a manner similar to "deviations," as described in Paragraph 1.4-A.9.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 E. below.

E. 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 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.

F. Approval or Rejection:

1. The Engineer will give written approval or rejection of substitution.
2. Owner reserves the right to require proposed product(s) to comply with color and pattern of specified product if necessary to secure design intent.
3. In event substitution results in a change of Contract price or time, provisions in General Conditions will be applied for adjustment.
4. Substitutions will be rejected if:
   a. Submittal is not through the Contractor with his stamp of approval.
   b. Requests are not made in accordance with this Section.
   c. In the Engineer's opinion, acceptance will require substantial revision of the original design.
   d. 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.

1.5 MAJOR EQUIPMENT AND SYSTEMS SUPPLIERS

A. Refer to Section 01062 - *Major Equipment and Systems Suppliers* for details regarding prequalification and approval of "Major Equipment and Systems" items.

1.6 BIDDER OFFERED SUBSTITUTIONS FOR MAJOR EQUIPMENT AND SYSTEMS SUPPLIERS

A. The Bidder may propose a substitute for any item of equipment, products, systems or suppliers listed in the "Schedule of Proposed Equipment Suppliers Form" in the Bid Form. No substitution will be considered unless listed by Bidder under Column F of the "Schedule of Proposed Equipment Suppliers Form".
   1. The Bidder shall indicate all proposed substitutions by listing in writing the substitute equipment, products, systems or suppliers and the addition or deduction to the Base Bid Price for the proposed substitute item in the spaces provided on the "Schedule of Proposed Equipment Suppliers Form".
   2. The Contractor may propose only one (1) substitution for each item listed on the "Schedule of Proposed Equipment Suppliers Form". No further substitutions will be considered.

B. Additions and/or deductions for proposed Bidder offered substitutions will not be considered in determining the lowest, responsive Bidder.

C. No proposed Bidder substitution will be considered unless, in the opinion of the Owner, it conforms to the requirements of the Contract Drawings and Specifications in all major respects, except for make, manufacturer or other minor details.

D. Proposed Bidder substitutions will be deemed as equal if the substitute is the same or better quality than the equipment, products, systems or suppliers specified under the Base Bid in terms of its function, performance, reliability, quality and general configuration.

E. Evaluation of the equality and final determination of Owner acceptance of any substitute item will be made by the Engineer after the Bid opening, based upon the receipt and review of required submittal data specified under the following Paragraph (1.6-F). The Bidder shall submit all required substitution data within five (5) working days of written request by Owner.

F. Required substitution data shall include:
   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 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.

8. Data and drawing information shall be specifically prepared for this project. Sales catalog cuts or marked up drawings from previous projects are not acceptable.

G. The design and preparation of these plans and specifications are based on products and equipment specified under the Base Bid. The Bidder shall be responsible for any and all changes necessary to accommodate the substitute items, including the costs for:
   1. Redesign.
   2. Revision of construction documents.
   3. Additional construction observation.

END OF SECTION

SECTION 01650

PROJECT SYSTEMS START-UP

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SECTION 01650

PROJECT SYSTEMS START-UP

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 for specified phases of construction and various Project Systems (System).
   2. Requirements for Substantial Completion Submittals.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 DEFINITIONS

A. Project System (System): A defined part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. Hereafter referred to as System.

B. 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 that each System has reached a state of Substantial Completion.
   2. Equipment Start-Up.
   3. Personnel training.

C. Demonstration Period: A period of time of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the System and starts up and operates the Project Systems, 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 a specified SYSTEM as evidence of Substantial Completion.

D. Substantial Completion: See - *General Conditions* under Time for Completion.

1.3 SUBMITTALS

A. Submit in the chronological order listed below prior to the completion of the Pre-Demonstration Period.
   1. Master operation and maintenance training schedule:
      a. Submit 30 days (minimum) prior to first training session for Owner's personnel.
      b. Schedule to include:
         1) Target date and time for Owner witnessing initial start-up of each System.
         2) Target date and time for Operation and Maintenance training for each System, both field and classroom.
         3) Target date for initiation of Demonstration Period.
      c. Submit for review and approval by Owner.
      d. Include holidays observed by Owner.
      e. Schedule planning and coordination meeting 90 calendar days prior to first anticipated training session.
         1) Provide a status report and schedule-to-complete for requirements prerequisite to manufacturer's training.

2) Identify initial target dates for individual manufacturer's training sessions.

f. Owner reserves the right to insist on a minimum 30 days' notice of rescheduled training session not conducted on master schedule target date for any reason.

g. Schedule to be resubmitted until approved.

2. Operation and Maintenance Manual.

a. Approved Operation and Maintenance manuals received by Engineer minimum three (3) weeks prior to scheduled training noted above.

3. Performance Certification

a. Written request for Owner to witness each system pre-demonstration start-up. Request to be received by Owner minimum one (1) week before scheduled training of Owner's personnel on that system.

b. Equipment installation and pre-demonstration start-up certifications.

c. Letter verifying completion of all pre-demonstration start-up activities including receipt of all specified items from manufacturers or suppliers as final item prior to initiation of Demonstration Period.

4. Substantial Completion Submittal:

a. File Contractor's Notice of Substantial Completion and Request for Inspection, allow at least two weeks from request for inspection to occur.

1.4 SEQUENCING AND SCHEDULING

A. System No.1 - Sedimentation Basin Improvements:

1. Installation of new tube settlers and orifice pipes.
2. Installation of sludge collection and tube cleaning equipment.
3. Tank wall modifications and anti-vortex device installation.
4. Tank drain and under basin excavation.

B. System No.2 - New Filter and Building Expansion:

1. Construction of clearwell addition, lower floor, upper floor, filter bay and roof of building expansion.
2. Installation of underdrain, air scour blowers, filter influent and effluent piping, backwash piping interior to the building, including portion in the clearwell addition.
3. Connection of new filter to 36-inch Sedimentation Basin effluent pipe.
4. Upgrade of fluoride system.
5. Installation of new filter control panel and integration with backwash pumps.
6. Finished water piping upgrade to chlorinators.

C. System No.3 - Finished Water Pump Station:

1. Construction of building, bridge crane, dual wet well troughs.
2. Installation of all finished water and backwash vertical turbine pumps.
3. Site work for installation of 36-inch clearwell effluent pipe, and finished water force main.
4. New finished water supply connection to existing plant building and chlorinators.
5. Connection of new finished water force main with existing finished water force main.
6. Demolition of existing finished water pumps and appurtenances.

D. System No. 4 - Raw Water Pump Station:

1. Install HVAC improvements in Raw Water Pump Station.
2. Run new electrical conduit to the Raw Water Pump Station.

E. Construction Priority:

1. Schedule completion of each system to minimize disruption of plant operations. Avoid situations that require the concurrent changeover and start-up of multiple systems at the same time. Ensure adequate time for plant staff to prepare for any process changes.
2. Phase work for in accordance with the construction phasing plan shown on the Drawings and in section 01060 - *Special Conditions.*

F. Work included as a part of each System shall include all site work, piping, utilities; mechanical, electrical, and control systems; and all other appurtenances, structures, temporary construction, temporary piping and utilities, and miscellaneous equipment as required for a complete and operational system.

1.5 COST OF START-UP

A. Contractor to pay all costs associated with System Start-Up.

PART 2 – PRODUCTS - NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 GENERAL

A. System(s) Start-Up shall be divided into two periods:
   1. Pre-Demonstration Period including:
      a. Completion of construction work to bring System to a state of Substantial Completion.
      b. Start-up 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 System.

B. Final Acceptance:
   1. Final acceptance of each individual System will not be issued by Owner. Final acceptance and project completion shall be in accordance with the *General Conditions* and shall pertain to completion of all work and not to an individual or specific System.

3.2 PRE-DEMONSTRATION PERIOD

A. Completion of Construction Work:
   1. Complete the work to bring each System to a state of substantial completion such that it can be inspected by the manufacturer's representative.

B. Equipment Start-Up:
   1. Requirements for individual items of equipment are included in Divisions 2 through Division 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. Procedures include but are not necessary limited to the following:
      a. Test or check and correct deficiencies of:
         1) Power, control, and monitoring circuits for continuity prior to connection to power source.
         2) Voltage of all circuits.
         3) Phase sequence.
         4) Cleanliness of connecting piping systems.
         5) Alignment of connected machinery.
         6) Vacuum and pressure testing of all closed systems.
         7) Lubrication.
         8) Valve orientation and position status for manual operating mode.
         9) Pumping equipment.
         10) Instrumentation and control signal generation, transmission, reception, and response. See Section 13440 - *Instrumentation for Process Control: Basic Requirements.*
         11) Tagging and identification systems.
         12) All equipment: Proper connections, alignment, calibration and adjustment.

b. Calibrate all safety equipment.
c. Manually rotate or move moving parts to assure freedom of movement.
d. "Bump" start electric motors to verify proper rotation.
e. Perform other tests, checks, and activities required to make the equipment ready for Demonstration Period.
f. Documentation:
1) Prepare a log showing each equipment item subject to this paragraph and listing what is to be accomplished during Equipment Start-Up. Provide a place for the Contractor to record date and person accomplishing required work. Submit completed document before requesting inspection for Substantial Completion certification.

4. Obtain certifications, without restrictions or qualifications, and deliver to Engineer:
a. Manufacturer's equipment installation inspection letters.
b. Instrumentation Supplier's Instrumentation Installation Certificate.

C. Personnel Training:
1. See individual equipment specification sections.
2. Conduct all personnel training after completion of Equipment Start-Up.
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 and classroom training requirements:
a. Hold classroom training on site.
b. 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.
c. Training instructor: Factory trained and familiar with giving both classroom and "hands-on" instructions.
d. Separate training sessions into maintenance and operation topic modules and identify on the schedule.
e. Plan for minimum class attendance of eight (8) 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 seven (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 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and the following areas as applicable to each System.
1) Operation of equipment.
2) Operational safety.
3) Capabilities.
4) Optimizing equipment performance.
5) Emergency situation response.
6) Troubleshooting of equipment.
7) Takedown procedures (disassembly and assembly).
8) Maintenance and repair of equipment.
9) Lubrication of equipment.
10) Preventive maintenance procedures.
11) Adjustments to equipment.
12) Inventory of spare parts.

h. At a minimum, address above paragraphs 1) through 6) in the operation sessions. Address above paragraphs 7) through 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.
3. Training material.

E. Filing of Contractor's Notice of Substantial Completion and Request for Inspection of System.
1. File the notice when the following have been completed:
a. Construction work (brought to state of Substantial Completion).
b. Equipment Start-Up.
c. Personnel Training.
d. Submittal of required documents.
2. Engineer will review required submittals for completeness within five (5) calendar days of Contractor's notice. If complete, Engineer will complete inspection of the Work, within ten (10) calendar days of Contractor's notice.
3. Engineer will inform Contractor in writing of the status of the Work reviewed, within 14 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 five (5) days of Engineer's determination.
2) Engineer: Reinspect work within five (5) days of Contractor's notice of correction of deficiencies.
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 Phase as a whole or for one or more System 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 of substantial completion attesting to the successful demonstration, and citing the hour and date of beginning the successful Demonstration Period of functional integrity as the effective date of Substantial Completion for System.

3.3 DEMONSTRATION PERIOD

A. General:
1. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of the respective equipment and components comprising the System as evidence of Substantial Completion.
2. Duration of Demonstration Period: 168 consecutive hours.
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 5 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 plant performance. Owner's assistance will be available only for process 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. Demonstration by System:
   a. Contractor may demonstrate by System, either individually or a combination of two or more Systems.
8. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.
9. 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.
10. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated. Power costs to demonstrate all systems will be paid by Owner.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Description of procedures to be followed and related work required to accomplish an orderly transfer of project closeout deliverables from the Contractor to the Owner.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 DEFINITIONS

A. Punch List: The stated qualification accompanying either the Engineer's Certificate of Substantial Completion or the Certificate of Final Payment, or any list of construction items found to be deficient or incomplete through review of the Work by Engineer and communicated in writing to Contractor at any time during the Contract Period.

B. Record Drawing: Drawing showing exact location of underground items and a complete record of the differences between the construction drawings and specifications and the completed installation.

1.3 SUBMITTALS

A. Substantial Completion:
   1. Contractor to notify Engineer in writing that the Contractor considers the Work as a whole to be in Substantial Completion in accordance with the Contract Documents and request for a Substantial Completion inspection.
   2. Record Drawings.
   3. Certificates of Inspection if required in local jurisdiction.
   4. A list of work (if any) not to be considered for Substantial Completion.

B. Final Completion:
   1. Contractor to notify Engineer in writing that the Contractor considers the entire Work to have progressed to final completion.
   2. When final completion and Substantial Completion are coincidental:
      a. Submittals required for Substantial Completion, and;
      b. Record Drawings;
      c. Lien waivers, or evidence of payment to subcontractors and suppliers.
   3. When final completion does not coincide with Substantial Completion:
      a. Substantial Completion submittals for portions of the work not previously considered substantially complete, if any, and;
      b. Record Drawings;
      c. Lien waivers, or evidence of payment to Subcontractors and Suppliers.

PART 2 – PRODUCTS - NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 SUBSTANTIAL COMPLETION, ADJUSTMENT AND RELEASE OF RETAINAGE

A. No partial payment of retainage will be made to Contractor at Substantial Completion. Retainage amounts deemed appropriate will be released with final payment.

3.2 INSPECTION FOR FINAL ACCEPTANCE AND PAYMENT

A. When the items of Work on the Punch List(s) have been completed, and Contractor considers the Work of the entire Project complete, the Contractor shall submit written certification that:
   1. Contract Documents have been reviewed.
   2. Work has been inspected for compliance with Contract Documents.
   3. Work has been completed in accordance with Contract Documents.
   4. Work has received Final Cleaning.
   5. Work is completed and ready for final inspection.

B. Engineer and Owner will make an inspection with the Contractor to verify the status of completion within fourteen (14) calendar days after receipt of such certification.

C. Should Engineer consider that the Work is incomplete or defective:
   1. Engineer will notify the Contractor in writing within seven (7) calendar days, listing the incomplete or defective work.
   2. Contractor shall remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.
   3. Engineer will reinspect the Work.

D. When Engineer finds the Work acceptable in accordance with the Contract Documents, Engineer will request Contractor to make closeout submittals.

3.3 FINAL APPLICATION FOR PAYMENT

A. Complete demobilization prior to submitting final application for payment.

B. Submit final application for payment in accordance with procedures and requirements stated in the Contract Documents.

C. Engineer will review application and recommend final payment within seven (7) calendar days of receipt of application.

END OF SECTION

SECTION 01710

CLEANING

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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 includes disinfection of all tanks and equipment intended to hold process water.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - 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 and NSF 61 approved.
   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, orders and safety regulations 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 nondegradable 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. On completion of work, leave area in a clean, natural looking condition. Remove all temporary construction and activities incidental to construction of required permanent Work.

H. Do not burn on-site.

3.2 INTERIOR CLEANING

A. Cleaning During Construction:
   1. Keep work areas clean so as not to hinder health, safety or convenience of personnel in existing facility operations.
   2. At maximum weekly intervals dispose of waste materials, debris, and rubbish.
   3. Vacuum clean interior areas when ready to receive finish painting. Continue vacuum cleaning on an as-needed basis, until substantial completion.
   4. Control dust in work areas of existing facilities.
      a. Provide protection to existing electrical and mechanical equipment as required to eliminate detrimental effects due to construction.

B. Final Cleaning:
   1. Complete immediately prior to Demonstration Period.
   2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed surfaces.
   3. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
   4. Wash and shine glazing and mirrors.
   5. Polish glossy surfaces to a clear shine.
   6. Ventilating systems:
      a. Clean permanent filters and replace disposable filters if units were operated during construction.
      b. Clean ducts, blowers and coils if units were operated without filters during construction.
   7. Replace all burned out lamps.
   8. Broom clean process area floors.
   9. Mop office and control room floors.
   10. Disinfect all basins, piping, and equipment per the latest revision of AWWA C653, AWWA C651, and AWWA C652.

3.3 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 or requested by Owner or Engineer's representative 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:
      a. Re-seed areas disturbed by location of trash and debris containers.
   2. Clean paved roadways.

3.4 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 01740

WARRANTIES AND BONDS

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SECTION 01740

WARRANTIES AND BONDS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

1.2 RELATED WORK

A. Instructions to Bidders: Bid or Proposal Bonds.

B. General Conditions.

C. Supplementary Conditions.

D. Section 01060 - *Special Conditions*.

E. Section 01700 - *Contract Closeout*.

F. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Division 2 through 16.

G. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

1.3 SUBMITTALS

A. Submit proposed warranties to the ENGINEER with relevant shop drawings.

B. Submit final warranties to the OWNER prior to Substantial Completion.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for approval prior to final execution.

D. Refer to individual Sections of Divisions 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.

1.4 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work. Work shall be accomplished such that disruption of water treatment plant operations are minimized.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

H. The Contractor shall provide a one-year warranty from the date of Substantial Completion for all of the work.

1.5 DEFINITIONS

A. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 – PRODUCTS - NOT USED.

PART 3 – EXECUTION - NOT USED.

END OF SECTION

SECTION 01800

OPENINGS AND PENETRATIONS IN CONSTRUCTION

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SECTION 01800

OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. All openings and penetrations in construction.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 318, Building Code Requirements for Reinforced Concrete.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Specification for Structural Steel.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   3. National Fire Protection Association (NFPA):
      a. 70, National Building Code (NEC).
      b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
   4. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

B. Obtain prior approval from Engineer when any opening larger than 100 SQ IN must be made in existing or newly completed construction.

1.3 DEFINITIONS

A. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.

B. Wash-down Areas: Areas having floor drains or hose bibs.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. For each structure provide dimensioned or scaled (minimum 1/8 IN = 1 FT) plan view drawings containing the following information:
      a. Vertical and horizontal location of all required openings and penetrations over 4 IN in diameter or 6 IN x 6 IN.
      b. Size of all openings and penetrations.
      c. Opening type.
      d. Seal type.
   3. Manufacturer's installation instructions for standard manufactured products.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pipe Sleeves: Steel, ASTM A53, Schedule 40, black.

B. Sheet Metal Sleeves: Steel, ASTM A36, 12 GA.

C. Commercial Wall Castings: Ductile iron, class equal piping system with minimum Class 53.

D. All materials in contact with process water shall meet NSF-61 approval.

PART 3 — EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install sleeves and castings in accordance with ACI 318, Chapter #6.

B. Hot dip galvanize (or paint in accordance with Section 09905) all steel sleeves installed.

C. When mechanical or electrical work cannot 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.

D. Where pipes, conduits or ducts pass through newly constructed floors in wash-down areas, cast sleeves with top 3 IN above finish floors. In non-wash-down areas, cast sleeves with ends flush with finished surfaces.

E. Where pipes, ducts or conduits pass through existing floors in wash-down areas and sleeves cannot be integrally cast, utilize drip sleeve detail as shown on Drawings.

F. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.

G. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.

H. Do not cut into nor core drill any beams, joists, or columns.

I. Do not install sleeves in beams, joists, or columns.

J. Do not install recesses in beams, joists, columns, or slabs.

K. Field Cutting and Coring:
   1. Saw or core drill with non-impact type equipment.
   2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.
   3. Sawcut opening outline on both surfaces. Knock out within sawcuts using impact type equipment. Do not chip or spall face of surface to remain intact.

L. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.

M. Provide water stop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.
   1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
   2. For commercial castings, cast water stop/anchor with wall pipe.
   3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
   4. For fabricated units, diameter of plate or flange to be 4 IN larger than outside diameter of sleeve, pipe or ductwork.
   5. For commercial castings, water stop/anchor size to be manufacturer standard.
   6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.

N. Where area is blocked out to receive sheet metal sleeve at later date:

1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete, which is placed later.
   a. Size blockout based on sleeve size required plus 4 to 6 IN each side of sleeve for concrete encasement.
   b. Provide #4 dowels at 12 IN spacing along each side of blockout with minimum of two dowels required per side.
2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.
   a. Size blockout based on sleeve size required plus 2 to 4 IN each side of sleeve for concrete encasement.

O. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.

P. Use full depth expanding foam sealant for seal applications into hazardous areas and applications where multiple pipes, conduits, etc. pass through single sleeve. Use full depth compressible sealant for applications involving single components passing through sleeves and for penetrations into non-hazardous area.

Q. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.

3.2 SCHEDULES

A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:
   1. Provide the following opening and penetration types:
      a. Type A - Block out 1 IN larger than outside dimensions of duct, pipe, or conduits.
      b. Type B - Saw cut opening. Place new concrete with integrally cast sheet metal or pipe sleeve.
      c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place.
      d. Type D - Commercial type casting.
      e. Type E - Saw cut opening. Place new concrete with integrally cast pipe, duct or conduit spools.
      f. Type F - Integrally cast pipe, duct or conduit with seep ring.
      g. Type G - Saw cut and remove area 1 IN larger than outside dimensions of duct, pipe or conduit.
      h. Type H - Core drill.
      i. Type I - Block out area. At later date, place new concrete with integrally cast sheet metal or pipe sleeve.
   2. Provide seals of material and method described as follows.
      a. Category 1 - Link-seal.
      b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Section 07600 and roofing specification sections for additional requirements.
      c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod and sealant used in sleeve annulus.
      d. Category 4 - Backer rod and sealant.
      e. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
      f. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum ½ IN larger than opening.
      g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
   3. Furnish openings and sealing materials through new floors, roofs, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.
   4. Furnish openings and sealing materials through existing floors, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

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SCHEDULE A
Openings and Penetrations Schedule for New Construction

Opening Applications	Ducts		Piping		Conduit	
	Opening Type	Seal Category	Opening Type	Seal Category	Opening Type	Seal Category
Through floor with bottom side a hazardous location	C	7	D	NOT REQ.	C	7
	F	NOT REQ.	F	NOT REQ.	F	NOT REQ.
	I	7	$I_{(1)}$	7		
Through floors on grade above water table	C	4	C	7	C	4
	F	NOT REQ.	F	NOT REQ.	F	NOT REQ.
	I	4	$I_{(1)}$	7	$I_{(1)}$	7
Through slab on grade below water table	F	NOT REQ.	F	NOT REQ.	F	NOT REQ.
	C	4	C	4	F	NOT REQ.
Through floors in wash-down areas	I	4	$H_{(2)}$	3	$H_{(2)}$	3
			$I_{(1)}$	4	$I_{(1)}$	7
Through walls where one side is a hazardous area	C	7	D	NOT REQ.	C	7
	F	NOT REQ.	F	NOT REQ.	F	NOT REQ.
	I	7	$I_{(1)}$	7		
Through exterior wall below grade above water table	C	7	C	1	F	NOT REQ.
	F	NOT REQ.	D	NOT REQ.	$I_{(1)}$	7
	I	7	F	NOT REQ.		
			$I_{(1)}$	7		
Through wall from tankage or wet well to dry well or dry area	C	7	C	1	C	7
	F	NOT REQ.	D	NOT REQ.	F	NOT REQ.
	I	7	F	NOT REQ.	$H_{(2)}$	7
				$I_{(1)}$	7	
Through exterior wall above grade	A	6	A	5	C	5
	B	6	B	5	$H_{(2)}$	4
	C	6	D	NOT REQ.		
			$H_{(2)}$	5		
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A	4	A	4	A	4
	C	4	C	4	C	4
					F	NOT REQ.

(1) Multiple piping 3 IN and smaller or multiple conduits.
(2) *Single piping 3 IN and smaller or single conduit.*

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SCHEDULE B
Openings and Penetrations Schedule for Existing Construction

Opening Applications	Ducts		Piping		Conduit	
	Opening Type	Seal Category	Opening Type	Seal Category	Opening Type	Seal Category
Through floors with bottom side a hazardous location	B	7	$B_{(1)}$	7	$B_{(1)}$	7
	E	NOT REQ.	$E_{(3)}$	NOT REQ.	$E_{(3)}$	NOT REQ.
			$H_{(2)}$	7	$H_{(2)}$	7
Through floors on grade above water table	B	7	B	7	B	7
Through slab on grade below water table	E	NOT REQ.	E	NOT REQ.	E	NOT REQ.
Through floors in wash-down areas	G	3	G	3	G	3
			$H_{(2)}$	3	$H_{(2)}$	3
Through walls where one side is in hazardous area	B	7	$B_{(1)}$	7	$B_{(1)(3)}$	7
	E	NOT REQ.	$B_{(3)}$	1	E	NOT REQ.
			E	NOT REQ.	$H_{(2)}$	7
			$H_{(2)}$	7		
Through exterior wall below grade above water table	B	7	$B_{(1)}$	7	$B_{(1)(3)}$	7
			$B_{(3)}$	1	$H_{(2)}$	7
Through wall from tankage or wet well to dry well or dry area	B	7	B	1	$B_{(1)(3)}$	7
	E	NOT REQ.	E	NOT REQ.	E	NOT REQ.
					$H_{(2)}$	7
Through exterior wall above grade	G	6	$G_{(1)(3)}$	5	$G_{(1)(3)}$	5
			$H_{(2)}$	5	$H_{(2)}$	7
Roof penetrations	G	2	G	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	$G_{(1)(3)}$	4	$G_{(1)(3)}$	4
			$H_{(2)}$	4	$H_{(2)}$	4

(1) Multiple piping 3 IN and smaller or multiple conduits.
(2) Single piping 3 IN and smaller or single conduit.
(3) Single pipe or conduit larger than 3 IN.

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3 **END OF SECTION**

SECTION 02050

SITE DEMOLITION

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SECTION 02050

SITE DEMOLITION

PART 1 – GENERAL

A. Related Documents:
   1. The drawings, all other applicable/related technical specifications, and general provisions of the agreement, including the general conditions and supplemental conditions apply to this section.

B. Summary: Remove asphalt pavement, concrete walks, inlets and piping and other structures indicated on drawings.

C. Restrictions:
   1. The use of explosives will not be permitted. Burning will not be permitted. The sale of salvage on-site will not be permitted.

D. Traffic:
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

1.2 PRODUCTS

A. Salvage:
   1. Store on the site at a location directed by the owner salvage items designated to be reused.
   2. Contractor is to remove and store on the site at the location directed by the owner any salvage items designated to remain the property of the Owner.
   3. Contractor may be required to transport some salvage items to Owner's warehouse, as indicated on the Drawings.

B. Materials Ownership:
   1. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

C. Satisfactory Soil Materials:
   1. Requirements for satisfactory soil materials are specified in "VDOT Road & Bridge Standards".
   2. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

1.3 EXECUTION

A. Pollution Control:
   1. Use water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air, to the lowest level of air pollution practical for the condition of work. Comply with the governing regulations.
   2. Clean adjacent structures and improvements of all dust, dirt, and debris caused by demolition operations, as directed by governing authorities. Return areas to condition existing prior to the start of the work.
   3. Refer to and follow approved Erosion and Sediment Control Plan.

B. Clearing and Grubbing:
   1. Remove from the site, trees, brush, shrubs, stumps, down timber, rotten wood, rubbish, and other vegetation as well as incidental structures necessary to allow for new construction.

2. Use only hand methods for grubbing inside the drip lines of trees which are to remain.

C. Filling Voids:

1. Completely fill below-grade areas and voids resulting from the demolition of structures.
2. Use satisfactory soil materials consisting of stone, gravel, and sand, free from debris, trash, frozen materials, roots and other organic matter, and free of stones larger than two inches in any dimension.
3. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash, and debris.
4. Place fill materials in horizontal layers not exceeding six inches in loose depth. Compact each layer at optimum moisture content of the fill material to a density equal to the original adjacent ground. After fill placement and compaction, grade the surface to meet adjacent contours and to provide flow to surface drainage structures.

D. Clean Up:

1. Clean up debris resulting from demolition continuously with the progress of the work.
2. Do not store or permit debris to accumulate on the site. If the contractor fails to remove excess debris promptly, the owner reserves the right to cause its removal at the contractor's expense.
3. Remove debris from site without spillage. Keep pavement areas adjacent to site clean and free from mud, dirt, and debris at all times.
4. Remove all tools, equipment, and materials from demolition of the site, and all rubbish upon completion of the work.
5. Leave the site clean, neat, and orderly and in a condition to begin new construction.

END OF SECTION

SECTION 02072

DEMOLITION, CUTTING, AND PATCHING

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SECTION 02072

DEMOLITION, CUTTING, AND PATCHING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition, cutting and patching.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete.*
   4. Section 09905 - *Painting and Protective Coatings.*

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Use only firms or individual trades qualified to perform work required under this Section.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Indicating manufacturer and type of proposed nonshrink grout and epoxy bonding adhesive.
   3. Indicating proposed materials and methods to be used for matching and repairing existing construction.

1.4 PROJECT CONDITIONS

A. Perform preliminary investigations as required to ascertain extent of work. Conditions which would be apparent by such investigation will not be allowed as cause for claims for extra costs.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate and reschedule work as required to preclude interference with other trades or with existing Water Treatment Plant operations.

B. Refer to project phasing plan.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Nonshrink grout:
      a. Supreme Grout by Gifford Hill.
      b. Masterflow 713 by Master Builders.
      c. SikaGrout 212 by Sika.
   2. Epoxy bonding adhesive:
      a. Euco No.452 MV by Euclid Chemical Co.
      b. Sikadur 32, Hi-Mod by Sika Corporation.

2.2 MATERIALS

A. Temporary Partitions:
   1. Plywood: 1/2 IN minimum for interior or exterior use.

B. Nonshrink Grout:
   1. Nonmetallic, noncorrosive and nonstaining.
   2. Premixed with only water to be added in accordance with manufacturer's instructions at job site.
   3. Grout to produce a positive but controlled expansion. Mass expansion not to be created by gas liberation or by other means.
   4. Minimum compressive strength at 28 days to be 6500 psi.
   5. Coat exposed edges of grout with a cure/seal compound recommended by grout manufacturer.

C. Epoxy Bonding Adhesive:
   1. Two component, moisture insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.

PART 3 — EXECUTION

3.1 INSTALLATION

A. Cutting and Removal:
   1. Remove existing work indicated to be removed, or as necessary for installation of new work.
   2. Neatly cut and remove materials, and prepare all openings to receive new work.
   3. Remove concrete in small sections.

B. Modification of Existing Concrete:
   1. Where indicated, remove existing concrete and finish remaining surfaces as specified in Division 3 - Concrete.
      a. Protect remaining concrete from damage.
      b. Make openings by sawing through the existing concrete.
      c. Concrete may be broken out after initial saw cuts in the event concrete thickness prevents cutting through.
      d. Where sawing is not possible, make openings by drilling holes around perimeter of opening and then chipping out the concrete.
         1) Holes shall be sufficient in number to prevent damage to remaining concrete.
   2. Oversize required openings in existing concrete 1 IN on all sides and build back to required opening size by means of nonshrink grout epoxy bonded to the existing concrete.
   3. Where oversized openings cannot be made, remove the concrete to the required opening size and cut back exposed reinforcing 1 IN from face of concrete and fill resulting holes with nonshrink grout.

C. Matching and Patching:
   1. Walls, ceilings, floors or partitions:
      a. Repair abutting walls, ceilings, floors or partitions disturbed by removal.
      b. Match and patch existing construction disturbed during installation of new work.
   2. Methods and materials:
      a. Similar in appearance, and equal in quality to adjacent areas for areas or surfaces being repaired.
      b. Subject to review of Engineer.

D. Salvaged Items:
   1. Thoroughly dry and clean all metal surfaces.
   2. Prime all bare metal in accordance with Section 09905 {09906}.
   3. Clean and lubricate motors and other moving parts.

4. Brace motors attached to flexible mountings until reinstallation.
5. Dispose of items or materials not designated for Owner's salvage or reuse. Promptly remove from site.
6. Do not store or sell Contractor salvaged items or materials on site.
7. Transport to Owner's warehouse at 25122 Regal Drive, Abingdon, Virginia, if requested by Owner.

E. Clean Up:
1. Transport debris and legally dispose of off site.

3.2 DEMOLITION

A. General Demolition:
1. Buildings and other structures to be demolished will be vacated and discontinued in use prior to start of work.
2. Owner assumes no responsibility for actual condition of structures to be demolished. Conditions existing at time of inspection for Bidding purposes will be maintained by Owner insofar as practicable. However, variations within structures may occur by Owner's removal and salvage operations prior to start of Contractor's demolition work.
3. Items of salvable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items not permitted on site.
4. Items scheduled for salvage and delivery to Owner shall be removed by Contractor and delivered to the storage location designated by Owner. The storage location is tentatively set as the shop located on Regal Drive in Abingdon, Virginia. Items shall be protected as necessary with temporary shelters, tarps, pallets, shrink wrap, heaters, or combinations of these and similar protection methods. Weather elements include humidity, moisture, heat, cold, UV exposure, and similar hazards. The following items are scheduled for salvage by Contractor and delivery to Owner:
   a. Existing pump control valves.
   b. Existing finished water fittings and flow measurement devices, including 16-inch magmeter located in the existing meter vault.
   c. Existing valves and operators.
   d. Existing electrical equipment as selected by the Owner.
   e. All miscellaneous metals not embedded in concrete.
5. Conduct demolition operations and removal of debris to ensure minimum interference with roads and other adjacent occupied or used facilities.
6. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities as well as persons by falling debris or other cause.
   a. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.
7. Promptly repair damage to adjacent facilities due to demolition. Repair shall be as directed by Engineer, at no cost to Owner.
8. Maintain existing utilities, indicated to remain, keep in service, and protect against damage during demolition.
9. Do not interrupt existing plant operations or utilities serving occupied or used facilities, except when authorized by Engineer. Provide temporary services during interruptions to existing utilities, as acceptable to Engineer.
10. Owner will shut off utilities serving each structure. Disconnect and seal indicated utilities as directed by the Engineer before starting demolition operations.

B. Building/Structures Demolition:
1. Demolish buildings and structures completely and remove from site. Use such methods as required to complete work within limitations of governing regulations.
   a. Small structures may be removed intact only when acceptable to Engineer and approved by authorities having jurisdiction.

2. Proceed with demolition in a systematic manner, from top of structure to ground. Complete demolition work above each floor or tier before disturbing any of supporting members on lower levels.
3. Demolish concrete and masonry in small sections.
4. Break up and remove concrete slabs-on-grade, unless indicated to remain.
5. Locate demolition equipment throughout structure and remove materials so as to not impose excessive loads to supporting walls, floors or framing.

C. Below-Grade Construction:
1. Demolish and remove all foundations, footings, concrete slabs on ground, and all other below-grade construction.
2. Disconnect and remove all underground utilities designated for demolition unless otherwise noted.

D. Filling Basements and Voids:
1. Completely fill below-grade areas and voids resulting from demolition. Areas of proposed construction may be left open if construction is to begin within one week of demolition.
2. Use approved fill materials consisting of granular material free from debris, frozen materials, organic matter, and rock larger than 3 IN in any dimension.
3. Prior to placement of fill, ensure that areas are free of standing water, frozen materials, and debris.
4. Place fill materials in horizontal layers not exceeding 6 IN loose depth. Compact each layer to a density equal to undisturbed adjacent ground.
5. After fill placement are compaction, grade surface to meet adjacent contours and provide positive surface drainage.

E. Disposal of Demolished Materials:
1. Concrete and masonry debris from demolished structures may be disposed on-site in spoil area fills designated by Engineer.
   a. Debris shall be placed in one lift not to exceed 3 FT in thickness and shall be broken to the extent possible by compaction with a crawler-type tractor.
   b. Debris shall be placed in non-structural fills and shall have a 5 FT minimum earth cover.
2. Remove all other demolition debris materials from the site and dispose in accordance with local, state, and federal codes for disposal of construction debris.
3. Do not burn debris materials on site.

END OF SECTION

SECTION 02100

SITE PREPARATION

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SECTION 02100

SITE PREPARATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Protection: Protect improvements and vegetation to remain within and beyond/outside limits of disturbance.

B. Demolition: Demolish and remove existing site improvements.

C. Removal: Clean-up, remove and dispose of undesirable material off-site.

D. Restoration: Restore existing finished surfaces disturbed to that of proposed finishes (preconstruction condition as a minimum).

1.2 RELATED SECTIONS

A. he drawings, all other applicable/related technical specifications, and general provisions of the agreement, including the general conditions and supplemental conditions apply to this section.

1.3 REGULATORY REQUIREMENTS

A. Conform to all applicable codes. These include but shall not be limited to those pertaining to erosion and sediment control and the disposal of debris.

B. Obtain all required permits from authorities having jurisdiction.

C. Coordinate demolition Work with utility companies. Notify them prior to starting and comply with their requirements.

1.4 PROJECT RECORD DOCUMENTS

A. Accurately record on Project Record Documents the actual locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients while preparing for disturbance and in providing protection of utilities. Distinguish between abandoned and functioning utility lines.

B. Limit of disturbance shall mean the extent that proposed subsurface utility work and surface improvements are indicated on Drawings or as delineated on Drawings.

PART 2 – PRODUCTS

2.1 MATERIALS: NOT USED.

PART 3 – EXECUTION

3.1 PREPARATION

A. Accept premises as found. Owner assumes no responsibility for conditions of site or continuation of conditions existing at time of advertisement.

B. Assure that all pertinent required permits have been obtained.

C. Verify all site conditions pertinent to this work.

D. Locate, identify and flag/mark for protection all bench marks, property corners and reference points. Verify that survey bench mark and intended elevations for the Work are as indicated.

E. Contractor shall lay out work and be responsible for all lines, elevations and measurements.

F. Drawings do not purport to show all objects existing on the site. Before commencing work, verify with the Architect all improvements to be protected, salvaged, relocated, removed or demolished. Existing utilities are indicated on the Drawings in accordance with available records.

G. Before any work is started, the Contractor shall contact all corporations, companies, individuals and local authorities owning, maintaining or regulating utilities, conduits, wires and pipes running to or on the property to make suitable arrangements for protection, handling, relocation, and/or removal and disposal/salvage of such line. Verify locations and elevations.

H. Before any work is started, the Contractor shall contact all state and local authorities owning, maintaining or regulating adjacent rights-of-way to make suitable arrangements for protection, handling, relocation, and/or removal and disposal/ salvage of such improvements involved in this Work (signs, structures, etc.). Verify locations, elevations and applicable codes.

I. Coordinate all work with local power company. Owner's representative will provide names for contacts with power officials.

J. Coordinate all work with other private utility companies located in project area.

3.2 PROTECTION

A. Erect and maintain temporary bracing, shoring, lights, barricades, warning signs, etc., all in accordance with applicable rules and regulations.

B. Protection of adjacent properties, waterways and the air:
   1. Any material which will result in dust shall be wet down during removal.

C. Protection of Reference Points: Protect and maintain all bench marks, property corners, monuments and other reference points from damage or displacement. Do not cover. Obtain accurate replacement of any that is disturbed, destroyed or moved due to the work and furnish a certificate by a professional civil engineer or land surveyor that all such items have been relocated accurately.

D. Protection of Existing Improvements
   1. Conduct site operations to ensure minimum interference with roads, streets, walks, utilities, and other adjacent improvements to remain. Do not close or obstruct street, walks or other facilities without written permission from authorities having jurisdiction and prior approval by the Owner.
   2. Use all means necessary to protect existing improvements designated to remain. In the event of damage, immediately make all necessary repairs and replacements as directed by the Architect.
   3. Salvageable Improvements: Carefully remove any items indicated to be salvaged. Protect, transport and turn over to the Owner, where indicated or directed, all those items indicated to be salvaged. Store on the Owner's premises, where indicated or directed, and suitably protect for later use all those items indicated to be removed and reused. This includes all signs, site furnishings, etc. within the construction limits.

E. Protection of Existing Utilities
   1. Existing utilities, encompassing all water systems, storm and sanitary sewer systems, gas lines, electrical systems, telephone and communication systems, etc., and all accessories thereto, underground, on the surface or overhead, located in or affected by

the construction of the work shall be relocated as required. Determine prior to construction, and report to the Owner's Representative in writing which utilities are to be removed or relocated by their respective owner.

2. Give advance notice to the Utility Owner of work to be removed or relocated. The work shall be performed by the Contractor or Utility Owner with arrangements and payment for this work being made by the Contractor.
3. If existing concealed utilities not shown or correctly indicated by the Contract Documents are encountered, the Contractor shall stop work in that area and notify the Owner's Representative and Utility Owner. Do not proceed until written instructions are received from the Owner's Representative.
4. The Contractor shall excavate with care to determine the exact location of existing utilities, including sizes and inverts. Also, mark and flag at this time for protection. This work shall precede conduit laying, trenching and other construction as far as practicable, to permit adjustments where required.

3.3 DEMOLITION

A. Honor indicated Limits of Construction and Disturbance.

B. Remove existing walks, pavement, and curbs where required for new construction or as indicated on the Site Drawings.

C. Conduct demolition operations in such a manner as to minimize disturbance to subsoil and creation of dust.

3.4 CLEANUP, REMOVAL, AND DISPOSAL

A. Clean up debris resulting from demolition continuously with the progress of the Work.

B. Remove debris, rock, extracted plant life, unsatisfactory and/or surplus (not being reused) soil materials, etc. from site.

C. Any debris, rock, extracted plant life, etc. designated to be removed from the site shall become the property of the Contractor and shall be disposed at the Contractor's expense.

D. Dispose of all material in accordance with all local, state and federal regulations governing same.

END OF SECTION

SECTION 02200

EARTHWORK

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02890 - *Siltation and Erosion Control.*

C. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Tests for the Moisture Density Relations of Soils and Soil Aggregate Mixtures Using a 5.5 LB Rammer and a 12 IN Drop.
      c. D1557, Tests for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using a 10 LB Rammer and a 18 IN Drop.
      d. D1682, Test Methods for Breaking Load and Elongation of Textile Fabrics.
      e. D2487, Classification of Soils for Engineering Purposes.
      f. D3786, Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Testing Method.
      g. D4253, Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      h. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certifications.
   4. Test reports:
      a. Soils inspection and testing results.

B. Samples:
   1. Submit samples and source of fill and backfill materials proposed for use.
   2. Submit samples and source of borrow materials proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fill and Backfill: Selected material approved by Soils Engineer from site excavation or from off site borrow.

B. Granular Fill Under Building Floor Slabs-On-Grade: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No.67 or No. 57.

C. Granular fill under footings if unsuitable soil is encountered; VDOT 21A.

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. Not marked to be removed.
   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. Omission or inclusion of utility items does not constitute non-existence or definitive 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.
   8. No materials shall be stored or stockpiled within 10FT of the drip line of any trees, unless approved by the Engineer.
   9. Box trunks of all trees which are to remain in place with 2 IN hood planks secured with strips.
   10. Take all necessary precautions to prevent interruption of plant operation.

B. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

C. Dispose of waste materials, legally, off site. Obtain written approval from property owner accepting material.

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 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 Soils 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 ROCK EXCAVATION

A. All rock excavation shall be unclassified.

B. The use of explosives shall be limited to the magnitude and location of the charge that will not cause damage to adjacent existing construction and utilities including existing facility through shock vibrations or other stress loadings. Provide adequate blanket protection to ensure that there will not be fragments of rock or other debris flying through the air when discharging explosives. Contractor to employ personnel certified by the Virginia Department of Transportation to execute blasting operations if the Owner requires such certification.
   1. The Contractor shall be responsible for any and all damages resulting from the use of explosives.

C. Where explosives and blasting are used, comply with all laws and ordinances of municipal, state, and Federal agencies relating to the use of explosives. Use qualified personnel for blasting and take proper precautions to protect property or the work from damage or injury from blast or explosion. Conduct preblast survey in the company of the Engineer to aid in determining any damage caused by blasting.
   1. Obtain all required explosives permitting.

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. Testing and payment shall be in accordance with Section 01060 - *Special Conditions*. 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:

Minimum Compaction

Location	Compaction Density
1. Sitework:	
Under Paved Areas, Sidewalks; & Above Piping:	
Cohesive Soils	95 percent, ASTM D698
Cohesionless Soils	75 percent relative density per ASTM D4253 and D4254
Unpaved Areas:	
Cohesive Soils	90 percent, ASTM D698
Cohesionless Soils	70 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

3.6 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:

1. In general, work includes, but is not necessarily limited to, excavation for structures, removal of underground obstructions and unsuitable material, backfilling, filling, 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 of 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. At transitions between rock and soil bearing conditions, over-excavate soil a minimum depth of 12 inches and replace with granular material conforming to VDOT No. 21A aggregate.
4. 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 or Soils Engineer.
5. 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. 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.
6. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
7. 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, and under equipment support pads 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, 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.
   b. Engineer will inspect subgrade material below foundation and slab of administration building. If uncontrolled (boulder) fill is present, over excavate and replace with suitable material.
   c. Engineer will inspect subgrade under all structures and tanks. If bedrock is encountered with fractures or soil seams, over excavate to a depth equal to twice the width of the seam. Backfill seams with flowable fill. Place maximum 12" thickness of granular material, properly compacted, below all structures and tanks.
8. Dewatering: Where groundwater is or is expected to be 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. Review soils investigation before

beginning excavation and determine where groundwater is likely to be encountered during 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, water plant 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.

9. 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.
10. 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°F before structure is completed and heated to a temperature of at least 50°F.
11. 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.
12. 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.
13. 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 described in the Erosion and Sedimentation Control Plan and that will not damage existing or new construction or interfere with construction operations.
14. 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°F.

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:
   a. Place all foundations, equipment support slabs, sumps and floor trenches on a minimum of 12 IN of granular fill unless otherwise indicated or rock subgrades are encountered.
   b. Place all floor slab-on-grade on a minimum of 6 IN of granular fill unless otherwise noted.
4. Where footings are overexcavated due to unsuitable material, backfill with VDOT 21A.
5. Geotextile filter fabric:
   a. Lap filter fabric 12 IN at splices.
   b. Cover punctures and tears with an additional layer of fabric lapped 12 IN all around.
   c. Do not puncture fabric with grade stakes or other items.
   d. Spread the drainage material over the filter fabric in the direction of the lap splice.
6. 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°F 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.
7. 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 applies 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°F 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:

1. 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.

2. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other sections of these Specifications.

3.7 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed off site. Clean roadways daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

B. Comply with all requirements of approved Erosion and Sedimentation Control Plan.

END OF SECTION

SECTION 02221

EXCAVATION, TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

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SECTION 02221

EXCAVATION, TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

1.1 SUMMARY

A. Section Includes:
   1. Excavation, trenching, backfilling and compacting for all underground utilities.
   2. Wastewater piping.
   3. Storm Sewers, channel, and drain piping.
   4. Water piping.
   5. Relocation of existing piping.
   6. All related utility and process appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02200 - *Earthwork.*
   4. Section 02515 - *Precast Concrete Structures.*

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, Concrete Aggregates.
      b. D698, The Moisture-Density Relations of Soils Using a 5.5 LB Rammer and a 12 IN Drop. D698 is "Standard Proctor."
      c. D1557, The Moisture-Density Relation of Soils Using a10 LB Rammer and an 18 IN Drop. D1557 is "Modified Proctor."
      d. D2487, Classification of Soils for Engineering Purposes.
      e. D4253, Maximum Index Density of Soils Using a Vibratory Table.
      f. D4254, Minimum Index Density of Soils and Calculation of Relative Density.
   3. U.S. Department of Labor - Occupational Safety and Health Administration.
      a. 29 CFR 1926 Subpart P - Excavations.

1.3 DEFINITIONS

A. Excavation:
   1. All excavation will be defined as unclassified, including, but not limited to, solid ledge rock in its natural location, which requires systematic quarrying, drilling and/or blasting for its removal, and also boulders.

1.4 SUBMITTALS

A. Submit respective pipe manufacturer's data regarding methods of installation and general recommendations.

B. Submit sieve analysis reports on all granular materials.

C. Submit trench dewatering plan to meet requirements of E&S Review Agency. Discharge water shall not immediately re-enter water course.

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 street 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.

E. Take necessary precautions to protect existing utilities from damage during construction activity. Repair damages to utility items at own expense. Assess no cost to Owner, Engineer or auxiliary party for any damages.

F. No material shall be stored within 10 feet of the dripline of any tree.

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.
   c. Frozen material shall not be used as fill or backfill.
   d. Initial Backfill and Final Backfill is further defined in PART 3 of this specification.
2. Improved Bedding Materials:
   a. ASTM C33, gradation 57 defined below:

Sieve Size	1.5 IN	1 IN	½ IN	No.4	No.8
Percent Passing by Weight	100	100-90	60-36	Max 7	Max 3

   1) Well-graded crushed stone.
   2) Well graded crushed gravel.

B. Subgrade Stabilization Materials: Provide when soil conditions are unstable.

1. As approved by the Engineer.
2. Granular bedding materials:
   a. ASTM C33, gradation 57 defined above.

PART 3 – EXECUTION

3.1 GENERAL

A. Remove and dispose of unsuitable materials as directed by Engineer to site provided by Contractor.

3.2 EXCAVATION

A. Unclassified Excavation:

1. Contractor shall remove and dispose of all rock required to install utility piping, manholes, all electrical conduit, and all appurtenances in accordance with the contract

documents as part of the lump sum price . No separate payment shall be made for rock excavation.

B. Excavation for Appurtenances:
   1. 12 IN (minimum) clear distance between outer surface and embankment.
   2. See Section 02515 - *Precast Concrete Structures* for applicable requirements.

C. Trench Excavation:
   1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
      a. Tunnel work for crossing under crosswalks, driveways or existing utility lines with permission.
         1) Limit tunnels to 10 FT in length.
   2. Open trench outside buildings, units, and structures:
      a. No more than the distance between two manholes, structures, units, or 150 LF, whichever is less.
      b. Field adjust limitations as weather conditions dictate.
   3. Fill in or close off trench at the completion of every work day.
   4. Observe following trenching criteria:
      a. Trench construction, including design, means and methods, safety procedures, and egress, shall be in accordance with 29 CFR 1926 Subpart P.
      b. Trench size.
         1) Excavate width to accommodate free working space.
         2) Maximum trench width at top of pipe shall not exceed the following dimensions:

Overall Diameter of Utility Service	Maximum Trench Width
4 IN - 10 IN	3' - 0"
12 IN - 24 IN	4' - 0"
27 IN - 36 IN	5' - 4"
42 IN - 48 IN	6' - 6"
54 IN - 60 IN	7' - 6"

         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. Include cost of dewatering in original proposal.
         5) Brace and sheet trenches as soil conditions dictate and in full compliance with OSHA requirements. Do not remove sheeting until backfilling has progressed to a stage that no damage to pipe will result due to removal.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:
   1. Backfill and compact to 95 percent of maximum dry density per ASTM D698.
   2. Backfill with granular bedding material as option.

B. Rock Excavation:
   1. Excavate minimum of 8 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. Initial Backfill:
   1. Furnish at the top of the bedding and install up to a level at least one foot above the crown of the pipe.
   2. Comply with the following:
      a. Place backfill in lifts not exceeding 6 IN (loose thickness).
      b. No lumps greater than 1 IN in diameter shall be allowed in initial backfill material.
      c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
      d. Compact each lift to specified requirements.
   3. Initial Backfill under roads or within two (2) feet of the edge of the pavement, curb or gutter, shall be as shown on the detail drawings.

C. Final Backfill:
   1. Perform in accordance with the following:
      a. Place backfill in 6 IN lift.
      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. No stone, rock, or earth clod larger than five (5) inches in its greatest dimension shall be used for backfill.
   2. Final backfill under roads or within two (2) feet of the edge of the pavement, curb or gutter, shall be as shown on the detail drawings.

D. Water flushing for consolidation is not permitted.

3.5 COMPACTION

A. General:
   1. Place and assure backfill and fill materials to 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.
   3. If settlement of trench backfill occurs within the one-year warranty and guarantee period, the Contractor shall correct the deficiency by filling, grading, and seeding in accordance with the contract documents.

B. Compaction Requirements: Compaction by "puddling" either natural or man-induced shall not be allowed. Final backfill in grassed areas shall be mounded three (3) IN above surrounding ground to allow for settlement. Unless noted otherwise on Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

Initial and Final backfill:

Minimum Compactions

Location	Soil Type	Density
Under parking lots, sidewalks, private roadways surfaces	Cohesive Soils	95 percent of max dry density by ASTM D698
Under turfed, sodded, plant seeded, nontraffic areas	Cohesive Soils	90 percent of max dry density by ASTM D698

3.6 TRENCH DEWATERING DURING WATER OR SEWER LINE INSTALLATION

A. All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during the pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in a manner satisfactory to the Owner. Contractor shall provide at least two (2) pumps for each trench opened in wet ground and at the same time, he shall have one (1) pump in reserve.

B. If, during any time, that Contractor is permitted to lay pipe in a trench containing unavoidable trench water and construction is interrupted for any reason, the open ends of pipe shall be closed by watertight plugs or caps, or other means approved by the Owner. In any case, such protection shall be provided when work is suspended overnight or on weekends and holidays, regardless of the condition of the trench with respect to water at the time that the work is suspended.

C. Contractor shall be responsible for the protection of all structures, including pipes and manholes, against any tendency to float under conditions of high water, whether due to high ground water or flood conditions on the project site. It shall be the responsibility of the Contractor to take whatever steps may be required, including the installation and operation of pumps and pumping systems, well points, or relief devices, to prevent any structure from floating during construction.

D. Cost of the necessary pumps, well points, or other appurtenances required to prevent flotation shall be included in the lump sum bid in the Proposal for the various bid items, and no extra compensation shall be allowed for such work. Any damage which may occur to any part of the work as the result of the flotation effect of ground or flood waters shall be repaired in a manner fully satisfactory to the Owner, at no additional cost to the Owner.

E. Contractor shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater, or other water, which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to natural watercourses. Existing sewers shall not be employed as a drain for the removal of dewatering wastes.

3.7 FIELD QUALITY CONTROL

A. Testing:
   1. Perform in-place moisture-density tests as directed by the Owner.
   2. Cost associated with "Failing" tests shall be paid by Contractor.
   3. Reference to Engineer in this section will imply Soils Engineer when employed by Owner and directed by Engineer to undertake necessary inspections as approvals as necessary.
   4. Assure Owner has immediate access for testing of all soils related work.
   5. Ensure excavations are safe for testing personnel.

END OF SECTION

SECTION 02486

TOPSOILING AND SEEDING

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SECTION 02486

TOPSOILING AND SEEDING

PART 1 – GENERAL

1.1 SCOPE

A. The work covered by this Section consists of furnishing all plants, seeds, labor, equipment and materials, and in performing all operations in connection with topsoiling and seeding the graded areas, all slopes adjacent to the graded areas, all non-paved shoulders and slopes, all disturbed or scarred areas, complete in strict accordance with the Plans, Details and Specifications and the guidelines set forth in the Virginia Erosion and Sediment Control Handbook (VESCH), most recent edition.

1.2 PRODUCTS

A. Seed:
   1. All seed used shall be labeled in accordance with U. S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of invitation for bids.
   2. All seed shall be furnished in sealed standard containers. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable.
   3. The permanent seed mix shall conform to the information shown on *Table 3.32-C - Site Specific Seeding Mixtures for Appalachian / Mountain Areas* of the VESCH manual. A copy of Table 3.32-C is shown at the end of this Section.

B. Fertilizer:
   1. Fertilizer shall be 5-20-10 grade, uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State fertilizer laws, and bearing the name, trade name or trade mark, and warranty of the producer.

C. Lime:
   1. Lime shall be ground limestone containing not less than 85 percent of total carbonates and shall be ground to such fineness that at least 50 percent will pass through a 100-mesh sieve and at least 90 percent will pass through a 20-mesh sieve.
   2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately; on the basis of quantities passing the 100-mesh sieve but no additional payment will be made for the increased quantity.

D. Topsoil:
   1. Topsoil to be used under this Section shall be topsoil removed and stockpiled under other sections. Additional topsoil if required under this Section shall be natural, friable material possessing the characteristics of representative soils in the vicinity, which produce heavy growths of crops, grass or other vegetation, and shall be obtained from naturally well-drained areas.
   2. The topsoil shall be reasonably free from clay lumps, stones, stumps, roots or other objects larger than 2 inches in diameter, toxic substances, or any other material or substance which might by harmful to plant growth or be a hindrance to grading and maintenance operations.
   3. Additional topsoil, if required, shall be furnished by the Contractor from his own sources off the site of the contract limits, at no additional cost.
   4. All topsoil shall be suitable to the Engineer.

E. Mulch:
   1. Mulching material shall consist of dry straw or any acceptable type as listed in the Virginia Erosion and Sediment Control Handbook and free of noxious weeds.
   2. Mulch shall not be musty, moldy, caked, decayed or extremely dusty.

PART 2 – EXECUTION

2.1 SPREADING OF TOPSOIL

A. On areas which are intended to be seeded, the compacted subgrade or slope shall be scarified to a depth of 2 inches for the bonding of topsoil with subsoil. Topsoil is then to be evenly spread, compacted and graded to a thickness of not less than 6 inches.

2.2 PREPARATION OF SEED BED

A. Fertilizer shall be distributed uniformly at over the areas to be seeded, and shall be incorporated into the soil to a depth of at least 3 inches by disking, harrowing, or other methods. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

B. Immediately following or simultaneously with the incorporation of the fertilizer, lime shall be incorporated into the soil to a depth of at least 3 inches by disking, harrowing, or other methods. The incorporation of the lime together with the fertilizer may be performed in one operation.

C. The topsoil shall have a minimum of 5.5 inches depth in all areas. Fertilizer application rates shall follow the guidelines set forth in the Virginia Erosion & Sediment Control Handbook (VESCH), most recent edition.

2.3 PLANTING SEED

A. All seeding work shall be done as soon as possible following final grading. When conditions are such, by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, the Engineer will stop the work, and work shall be resumed only when conditions are favorable again or when approved alternate or corrective measures and procedures have been put into effect.

B. If uneven growth results after seeding operations, the Engineer may require the sowing of additional seed on these areas.

C. Seed shall be broadcast either by hand or approved sowing equipment.

D. Seeding mixture and application rates shall follow the guidelines set forth in the Virginia Erosion & Sediment Control Handbook (VESCH), most recent edition.

E. For the project area, mixture and application rates shall follow *Table 3.32-C - Site Specific Seeding Mixtures for Appalachian / Mountain Areas* of the VESCH manual. A copy of Table 3.32-C is shown at the end of this Section.

F. The seed shall be uniformly distributed over the designated areas.

G. The seed shall be covered to an average depth of ¼ inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved device.

H. Broadcast seeding shall not be done during windy weather.

2.4 COMPACTING

A. Immediately after the operations specified above have been completed, the entire area shall be compacted by means of a cultipacker, roller, or other approved equipment weighing 60-90 pounds per linear foot of roller. When a cultipacker or similar equipment is used, the final rolling shall be at right angles to the existing slopes to prevent water erosion, or at right tangles to the prevailing wind to prevent dust, as directed by the Engineer.

2.5 MULCHING

A. Mulch shall be spread over all seeded areas at the rates listed in the Virginia Erosion and Sediment Control Handbook.

B. Mulch shall be applied to a uniform depth by an approved method and in such a manner that not more than 10 percent of the soil surface is exposed.

C. The use of wet hay or straw will not be permitted.

2.6 MULCH ANCHORING

A. Straw mulch shall be anchored by one of the methods listed in the latest edition of the Virginia Erosion and Sediment Control Handbook.

2.7 PROTECTION AND MAINTENANCE

A. The area shall be protected against traffic or other use after seeding is completed.

B. Seeded areas shall be maintained by mowing to the satisfaction of the Engineer.

C. Any areas which do not produce a healthy show of grass shall be re-seeded at the contractor's expense.

2.8 HYDRO-SEEDING

A. At the Contractor's option, hydro-seeding methods may be used in lieu of previously described methods for the placement of seed.

2.9 LIME

A. Lime shall be applied to all re-seeded areas at the rate of two (2) tons per acre.

END OF SECTION

SECTION 02510

CONCRETE CURBS, WALKS, AND PAVING

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SECTION 02510

CONCRETE CURBS, WALKS, AND PAVING

PART 1 – GENERAL

A. Submittals: In addition to Product Data, submit design mixes for each concrete pavement mix.
   1. Submit material certificates signed by manufacturers certifying that each concrete material complies with requirements.

B. Quality Assurance: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
   1. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
   2. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Job Conditions:
   1. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
   2. Provide flagmen, barricades, warning signs and warning lights as required.

PART 2 – PRODUCTS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

B. Steel Reinforcement Materials: As follows:
   1. Plain-Steel Welded Wire Fabric: ASTM A 185, flat sheets.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
   3. Plain Steel Wire: ASTM A 82, as drawn.
   4. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening steel reinforcement; manufactured according to CRSI's "Manual of Standard Practice".

C. Concrete Materials: As follows:
   2. Portland Cement: ASTM C 150, Type I or II.
      a. Fly Ash: ASTM C 618, Class F or C.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
   3. Aggregate: ASTM C 33, uniformly graded, from a single source.
   4. Water: Potable.

D. Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures, as follows:
   1. Air-Entraining Admixture: ASTM C 260.
   2. Water-Reducing Admixture: ASTM C 494, Type A.
   3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
   4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
   5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

E. Curing Materials: As follows:
   1. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
   2. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

3. Water: Potable.
4. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
5. Clear Solvent-Borne Liquid-Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
6. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
7. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

F. Related Materials: As follows:
1. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
2. Coloring Agent: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

G. Concrete Mixes: Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, with the following properties:
1. Compressive Strength (28 Days): 3500 psi (24.1 MPa).
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches (100 mm).
4. Air Content: 4.5 to 7.5 percent.

H. Coloring Agent: Add coloring agent to mix according to manufacturer's written instructions.

I. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

J. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.

K. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

PART 3 – EXECUTION

A. Surface Preparation: Proof-roll prepared subbase, and remove loose material from surface.

B. Forms:
1. Set forms to the required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of the work and so that forms can remain in place at least 24 hours after concrete placement.
2. Check completed formwork for grade and alignment to the following tolerances:
a. Top of Form Units: Not more than 1/8" in 10'.
b. Vertical Face: Longitudinal axis, not more than ¼" in 10'.
3. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

C. Reinforcement: Accurately position and support reinforcement, and secure against displacement. Set wire ties with ends directed into concrete.
1. Install welded wire fabric in lengths as long as practicable; lap at least one full mesh, and lace splices with wire.

D. Joints:
1. General:
a. Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise shown. Construct transverse joints at right angles to the centerline, unless otherwise shown.

b. When jointing existing structures, place transverse joints to align with previously placed joints, unless otherwise shown.

2. Weakened-Plane (Contraction) Joints:
   a. Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on the drawings.
   b. Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer. Construct tooled weakened-plane joints to a depth equal to at least ¼ concrete thickness.
   c. When permitted, use embedded strips of kraft paper or 6 mil polyethylene to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.
3. Construction Joints:
   a. Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than ½ hours. All pours shall terminate at expansion joints or weakened-plane joints.
   b. Construction joints as shown, or if not shown, use standard metal keyway section forms.
4. Expansion Joints:
   a. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects.
   b. Locate expansion joints at 25' o.c. for each pavement lane, unless otherwise shown.
   c. Extend joint fillers full-width and depth of joint, and not less than ½" or more than 1" below finished surface. Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together. Form top edge of filler to conform to top profile of concrete.
   d. Protect the top edge of the joint filler during concrete placement with a metal cap or other temporary materials. Remove protection after both sides of joint are placed.

E. Concrete Placement: Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete. Place concrete in a continuous operation within planned joints or sections.
   1. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
   2. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping according to recommendations in ACI 309R.
   3. Screed and initial-float concrete surfaces with darby or bull float before excess moisture or bleed water appears on the surface.
   4. Protect concrete from cold or hot weather during mixing, placing, and curing.

F. Evaporation Retarder: Apply to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

G. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surfaces to true planes with gaps below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch (6 mm). Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
   2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

H. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Cure concrete by one or a combination of the following methods:
   1. Moisture cure concrete by water, continuous fog spray, continuously wet absorptive cover, or by moisture-retaining-cover curing. Keep surfaces continuously moist for not less than seven days.
   2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

I. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

J. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

K. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

L. Machine Laid Curbs: All drives or paving where shown on the drawings shall have concrete machine curbs formed to the pattern called for and laid on the top of the base course. Concrete shall be placed within 2 hours after loading at the plant. Provide ½" thick premolded expansion joints not over 25' apart.

M. Repairs and Protections:
   1. Repair or replace broken or defective concrete, as directed by Architect.
   2. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
   3. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION

SECTION 02512

FOUNDATION DRAIN SYSTEM

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SECTION 02512

FOUNDATION DRAIN SYSTEM

1.1 SUMMARY

A. Section Includes:
   1. Foundation drain systems.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. *Division 1 - General Requirements.*
   3. Section 02423 - *Storm Drainage System.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO).
      a. M189, Standard Specification for Asbestos-Cement Perforated Underdrain Pipe.
   2. American Society for Testing and Materials (ASTM):
      a. C14, Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
      b. C444 Specification for Perforated Concrete Pipe.
      c. C508 Specification for Asbestos Cement Perforated Underdrain Pipe.
      d. C700 Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
      e. D3034 Specification for Type PSM Poly (vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.3 SYSTEM DESCRIPTION

A. Foundation Drainage System:
   1. System which drains by gravity, connects to and drains into storm drain system as shown on Drawings.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Filter fabric:
      a. Mirafi 140N by Mirafi Inc.
      b. Propex by Amoco Fabrics Co.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 DRAIN PIPE

A. Drain Pipe:
   1. Inside diameter: 4 IN.
   2. Provide fittings whose thickness, weight, material and quality correspond to that of the drain pipe approved for use.
      a. PVC pipe:
         1) ASTM D3034, SDR 35.
         2) Perforations in accordance with AASHTO M189, except perforations not to be greater than 5/16 IN DIA.

B. Filter Material: Graded gravel or crushed stone meeting the following sieve analysis:

Sieve Size	Percent Passing
1 IN	95 - 100
3/8 IN	20 - 85
No. 10	0 - 10
No. 200	0 - 3

C. Filter Fabric:
   1. Unwoven polypropylene fabric.
   2. Not less than 4 OZ/SY.
   3. Resistant to the chemical actions of the soil and water and nonbiodegradable.
   4. Fabric to prevent the migration of soil particles into the filter material while allowing the free flow of water from the subsoil to the drain pipe.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Lay filter fabric with 12 IN minimum laps at splices. Spread filter material in same direction as fabric overlap. Patch tears and holes in fabric with piece of same fabric material large enough to cover the tear or hole plus a 12 IN overlap.

B. Lay drain pipe lines firmly bedded in filter material to true grades and alignment with invert elevation shown on Drawings. Unless indicated otherwise on Drawings, install pipes level to point of discharge with perforations down and joints closed. Make joints with sleeve type couplings or tapered couplings. Provide couplings suitable for holding pipe firmly in alignment without use of sealing compounds or gaskets. Face bells upgrade away from point of discharge. Use 1/8 bends for change in direction; use Y fittings at intersections.

C. Test drain lines with water to assure free flow before covering. Remove obstructions and retest until satisfactory.

D. Provide filter material around drain pipes of depths and thicknesses shown on Drawings. Compact filter material with vibrator tamper to density required to preclude and to avoid damage to drain pipe and to filter fabric. Avoid damage to foundation.

E. Install standard pipe (non-perforated) to catch basin.

END OF SECTION

SECTION 02515

PRECAST CONCRETE STRUCTURES

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SECTION 02515

PRECAST CONCRETE STRUCTURES

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete manhole structures and appurtenant items.
      a. Manholes and appurtenances.
   2. Miscellaneous precast structures.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M198, Standard Specification for Asbestos-Cement Underdrain Pipe.
   2. American Society for Testing and Materials (ASTM):
      a. A48, Gray Iron Castings (Class 35 Minimum).
      b. A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
      c. A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
      d. C150, Portland Cement.
      e. C443, Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
      f. C478, Precast Reinforced Concrete Manhole Sections.
      g. C923, Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
      h. D1227, Emulsified Asphalt Used As a Protective Coating for Roofing.
      i. D4022, Coal Tar Roof Cement, Asbestos Containing.
      j. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
   3. Occupational, Health and Safety Administration (OSHA).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - Shop Drawings, Product Data & Samples; Operations and Maintenance Manuals and Miscellaneous Submittals.
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Fabrication and/or layout drawings:
      a. Include detailed diagrams of manholes showing typical components and dimensions.
      b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.
      c. Indicate knockout elevations for all piping entering each manhole.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Manhole steps, rings, covers and frames:
   a. Neenah Foundry.
   b. Deeter Foundry.
   c. Capital Foundry.
   d. East Jordan Iron Works.
   e. Or approved equal.
2. Black mastic joint compound:
   a. Kalktite 340.
   b. Tufflex.
   c. Plastico.
   d. Or approved equal.
3. Premolded joint compound:
   a. Ram Nec.
   b. Kent Seal.
   c. Or approved equal.
4. Coal tar epoxy:
   a. Koppers 300M.
   b. Or approved equal.
5. High build epoxy:
   a. Sika Sikagard 62.
   b. Tamms Duralkote.
   c. Kaufman SurePoxy.
   d. Or approved equal.
6. Fibered asphalt compound:
   a. Sonneborn Hydrocide 700B Semi-Mastic.
   b. Or approved equal.
7. Flexible connections:
   a. Kor-N-Seal.
   b. A-Lok Products.
   c. Press-Seal Corporation.
   d. Or approved equal.
8. Waterproof anchoring cement:
   a. Thoro System Products Thorogrip.
   b. Or approved equal.
9. External Frame and Joint Seal
   a. Con Seal.
   b. Sealing Systems.
   c. Or Approved Equal.

B. Submit request for substitutions in accordance with Specification Section 01640.

2.2 MANHOLE COMPONENTS

A. Manhole Steps:

1. Provide each manhole with extruded aluminum manhole steps with safety tread. Furnish spacing and dimensions of steps complying to OSHA requirements for fixed ladders.
2. Provide maximum distance from surface to first rung of not greater than 16 IN and maximum spacing on remaining steps of 16 IN OC. Locate step such that center of rung is nominal 7 IN clear of wall.
3. Minimum step width of 12 IN and minimum cross section of 0.875 IN of solid material.
4. Embed a minimum of 3 IN and anchor integrally into manhole or structure walls.

B. Special Coatings and Joint Treatment:
   1. Joints of precast sections:
      a. Manholes and Wet Well:
         1) Butyl rubber joint sealant.
         2) Butyl mastic joint sealant in accordance with ASTM C443 and ASTM C1244.
   2. Exterior Vertical wall surfaces:
      a. Manholes and Wet Well:
         1) Factory coated in accordance with the manufacturer's recommendation. Coating shall be high build epoxy, Con-Seal CS-55, coal tar epoxy meeting ASTM D4022, or emulsified fibered asphalt compound meeting ASTM D1227. Coating shall be applied in two (2) coats to a minimum total thickness of 16 mils.

C. Manhole Concrete:
   1. Provide all sanitary manholes constructed with Portland ASTM C150, Type I or II cement with a tricalcium aluminate content not to exceed 8 percent.
   2. Mix aggregate shall be a minimum of 50 percent crushed limestone.
   3. Provide 3000 psi non-shrink grout.

D. Manhole Components:
   1. Reinforcement: ASTM C478 and ASTM A615. Minimum wall thickness: 5 IN.
   2. Minimum base thickness: 12 IN.
   3. Provide the following components for each manhole structure:
      a. Base (precast) with integral bottom section or (cast-in-place).
      b. Precast bottom section(s).
      c. Precast barrel section(s).
      d. Precast eccentric transition section.
      e. Precast adjuster ring(s).
      f. Precast concrete transition section.
      g. Precast flat top.
   4. Unless dimensioned or specifically noted on Drawings, provide manholes with minimum 48 IN inside dimensions for depths less than 12 FT and manholes with minimum 60 IN inside dimensions for depths greater than 12 FT.
   5. For manholes located within the 100-year flood elevation, provide a minimum 4-inch horizontal footer around perimeter of manhole base.

E. Standard Type Frames and Cover:
   1. Cast or ductile iron frame and covers: ASTM A48, Class 35 (minimum).
   2. Use only cast or ductile iron of best quality, free from imperfections and blow holes.
   3. Furnish frame and cover of heavy-duty construction a minimum total weight of 450 LBS.
   4. Machine all horizontal surfaces.
   5. Furnish unit with solid nonventilated lid with concealed pickholes. Letter covers "Washington County Service Authority".
   6. Ensure minimum clear opening of 24 IN DIA.

F. Watertight Type Frame and Cover:
   1. Furnish frame and bolted cover of heavy-duty construction. Equip unit with six countersunk 3/8 IN DIA by 1½ IN long with brass washers.
   2. Provide machined horizontal surfaces and furnish solid lid and minimum 1/8 IN thick x ½ IN wide continuous strip neoprene gasket.
   3. Furnish unit with a minimum of six anchorage holes and six 6 IN long x 3/4 IN DIA anchor bolts.
   4. Provide covers with cast letters, marked as per paragraph 2.2E.
   5. Ensure clear opening of 24 IN.
   6. Provide watertight type frame and cover where indicated on Drawings.

G. Manhole Connections:
   1. ASTM C923 with flexible pipe to manhole connection in accordance with ASTM C923.
      a. If rubber boot type used, minimum wall thickness: 3/8IN.
      b. If required, all external clamps shall be stainless steel conforming to ASTM A167.

H. Manholes and wet wells shall utilize an external frame and joint seal at all joints.
   1. Seal shall be made out of EPDM rubber in accordance with ASTM D412 or Polyolefin Backed Exterior Joint Wrap in accordance to ASTM E-1745, C-877, and C990.
   2. EPDM Seal shall have a minimum thickness of 60 mils. Seal width shall be 12 inches.
   3. Polyolefin Backed Exterior Joint Wrap shall have a backing band element with minimum thickness of 4 mil. And Butyl Roller Adhesive with minimum thickness of 60 mil.
   4. Seal shall aggressively bond to concrete and metal structures.

2.3 MISCELLANEOUS PRECAST STRUCTURES

A. Precast reinforced concrete structures shall be constructed in accordance with ASTM C478 and have minimum dimensions as noted on the Drawings. All reinforcing steel shall conform to ASTM A615.
   1. All precast structures shall be AASHTO H-20 load rated.

B. Special Coatings and Joint Treatment:
   1. Provide tongue and groove joints in sections with a preformed groove for the placement of an O-ring type, rubber gasket.
      a. Gasket shall comply with the requirements of ASTM C443.
      b. Gasket shall seal the joint from either internal or external hydrostatic pressure.
   2. Circular structures shall be provided with single O-ring gasket concrete joints in accordance with ASTM C443.

C. All base sections and floor slabs shall be monolithic.

D. If anchors and appurtenances are not cast into structure they shall be installed by drilling the structure and installing with a waterproof anchoring cement. All manufacturer's recommendations shall be followed.

E. Pipe penetrations shall be by wall sleeve and link seal unless otherwise shown on the Drawings.

F. Provide access hatch as shown on Drawings and specified in Section 08305 - *Access Doors*.

PART 3 – EXECUTION

3.1 MANHOLE CONSTRUCTION

A. General:
   1. Utilize precast concrete base with integral bottom section.
   2. Ensure accurate vertical placement and leveling prior to placement of interior grout. Provide vertical alignment tolerance of maximum 1 IN horizontal to 10 FT vertical.
   3. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections. Shape inverts accurately and give them a steel trowel finish. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit.

B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.

C. Joints
   1. For all horizontal mating surfaces between concrete and concrete and concrete and metal, apply to Specified sealant in accordance with ASTM C443 and meeting ASTM C1244 testing standards.

D. Lifting holes shall be tapered and plugged up with rubber stoppers and an approved non-shrink grout after installation. There shall be no more than 2 lifting holes per manhole section.

E. Manhole connections shall be flexible Pipe to manhole connections in accordance with ASTM C923.

1. The port to receive the boot shall be cast in or core drilled and is to be manufactured as to allow for lateral and vertical movement, as well as angular adjustment through 20 degrees. All field installation of pipe through manhole seal shall be done in accordance with the manufacturer's recommendations.

F. Set and adjust frame and cover final 6 IN (minimum) to 12 IN (maximum) to match finished pavement or finished grade elevation using precast adjuster rings. Rings shall be installed in accordance with the Plan set details. Final manhole cover elevations shall be as specified below unless otherwise noted:

1. Lawn areas: 1 IN below finished grade.
2. Pavement areas: Finished grade.

3.2 BEDDING

A. Unless otherwise noted, all precast structures shall be placed on a compacted ASTM C33 Graduation No. 57 stone bed with a minimum thickness of 8 inches.

3.3 PLACEMENT

A. Precast structures shall not be placed on muddy or frozen subgrade.

B. The excavation for the structure shall be dry when the structure is placed.

C. The Contractor is responsible for insuring that the invert elevations specified in the Contract Drawings can be met by the precast structure.

3.4 FIELD QUALITY CONTROL

A. Wet Well and Manhole Testing - General:

1. Vacuum Testing:
   a. With approval of the Engineer, manholes shall be testing by the vacuum method. Manholes shall be tested after assembly and after backfilling.
   b. Installation and operation of vacuum equipment shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer.
   c. A measured vacuum of 5.0 psi (10 in Hg) shall be established in the manhole. The time for the vacuum to drop to 4.4 psi (9 in Hg) shall be measured.
   d. The maximum allowable leakage time shall be 60 seconds for manholes 10' or less deep, 75 seconds for manholes between 10 and 15' deep, and 90 seconds for manholes deeper than 15'. Add 15 seconds to each allowable time for each foot of manhole diameter over 4'.
   e. If the manhole fails the test, necessary repairs shall be made, and the test repeated until the manhole passes the test.

END OF SECTION

SECTION 02660

WATER MAIN CONSTRUCTION

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SECTION 02660

WATER MAIN CONSTRUCTION

1.1 SUMMARY

A. Section Includes:
   1. Coordination and interface with existing facilities and utilities.
   2. Connections to existing water mains.
   3. Testing, flushing and disinfection.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02260 - Topsoiling and Finished Grading.
   4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
   5. Section 15100 - Valves: Basic Requirements.
   6. Section 15101 - *Gate Valves.*
   7. Section 15510 - *Fire Hydrant.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Work Association (AWWA):
      a. B300, Standard for Hypochlorites.
      b. B301, Standard for Liquid Chlorine.
      c. C600, Standard for Installation of Ductile-Iron Water Mains.
      d. C651, Standard for Disinfecting Water Mains.
      e. All other applicable AWWA Standards.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:

B. Submit results of the leakage tests, identifying the specific length of pipe tested, the test pressure, the duration of test and the amount of leakage.

C. Submit satisfactory bacteriological test reports on disinfection requirements.

D. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 – PRODUCTS

A. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Pipe: Refer to Sections 15060.

B. In-Line Valves:
   1. Refer to Sections 15100.

C. Fire Hydrants: Refer to Section 15510.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install water main to the line and grade on the Drawings. Water mains to be staked at a minimum 100 FT interval with depth of cuts monitored.

B. Field verify depth of utilities that will be crossed.
   1. Adjust water main elevation as required during construction.
   2. No separate payment will be made for field verification or adjustment of main depths as required.

C. Contractor will restore all existing structures or services damaged by Contractor's operations at no cost to Owner.

3.2 CORRUPTION OF SERVICE

A. Interruption of service to water users shall not exceed the time specified in Section 01060.

3.3 UNDERGROUND SERVICES

A. Notify utility representative prior to construction to obtain available information on location of existing utilities. The Contractor shall be responsible for locating all utilities.

B. Existing water services are to be connected to the new water mains. Damage to existing water service to be repaired, using copper pipe and union the same size as existing service.

3.4 DRIVEWAY REMOVAL AND REPLACEMENT

A. All Portland cement concrete and asphalt noted for removal and replacement shall be cut prior to removal. Cut by sawing, vertical cut to be 1 IN minimum. The remaining depth of section may be broken out in a manner subject to Engineers approval. Width of section removed to be either a width not greater than the outside diameter of the water main plus 4 FT to 0 IN or broken out to the nearest joint.

B. Debris resulting from the above operations shall be removed and hauled as directed by the Engineer.

3.5 PROTECTION OF EXISTING UTILITIES

A. Contractor to verify the location of all underground utilities. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.

B. A representative of the underground utilities shall be notified 24 HRS in advance of crossings.

3.6 CONNECTIONS TO EXISTING WATERMAINS

A. Make connections to existing water mains as shown on Drawings, by attaching to existing or changed fitting.

B. Where the connection is made to an existing water main which can be adequately isolated from the distribution system, it shall be termed a "dry connection."

C. Contractor is responsible for controlling and disposing of water in the trench at no additional cost to the Owner.

3.7 SEWER CROSSINGS

A. Water mains crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a vertical separation of at least 18 IN between the bottom of the water main and the top of the sewer, whenever possible. A water main may be laid closer than 10 FT if the crown of the sewer is at least 18 IN below the water main invert. In the event 18 IN of vertical separation cannot be provided at a sewer crossing, the sewer shall be removed for a distance of 10 FT on each side of the water main and replaced with one 20 FT length of ductile iron pipe of the same size.

B. Concrete collars shall be provided at each end of the ductile iron pipe to connect to the existing sewer pipe as shown on the Drawings.

C. Payment for crossings shall be included in the bid unit price of the water main.

3.8 SEALING, FLUSHING, AND DISINFECTION OF POTABLE WATER SYSTEMS

1. Maintain interior of all pipes, fittings and other accessories free from dirt and foreign material at all times. 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. At close of day's work or whenever workmen are absent from job site, 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.
2. After favorable performance of pressure test and prior to final acceptance, thoroughly flush the entire potable water piping system and perform disinfection as prescribed. Perform all work including preventative measures during construction in full compliance to AWWA C651.
3. Flush each segment of the system to provide a flushing velocity of not less than 2.5 FT per second.
4. Drain flushing water to location approved by the Owner.
5. Perform disinfection using one of the following forms:
   a. Application of chlorine gas-water mixture by means of solution-feed chlorinating device. Liquid chlorine shall comply with AWWA B301.
   b. Application of calcium hypochlorite, or sodium hypochlorite. Chlorine compounds shall comply with AWWA B300.
6. Disinfect pipe with chlorinated water as per AWWA C651. Method of application of chlorine shall be by continuous feed method or slug method. 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. Cost of testing shall be included in the Bid Unit Price for water mains and no separate payment will be made for this item.
7. Tag the system during the disinfection procedure.
8. Following disinfection for required contact period, neutralize chlorine residual in water by treating with reducing agent. (Refer to AWWA C651) Flush all treated water from pipeline at its extremities until replacement water throughout pipe, upon test is 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. Quality of water delivered by the new water main to remain satisfactory for a minimum period of 2 days.
9. Secure satisfactory bacteriological reports on samples from the system. Ensure all sampling and testing procedures are in full compliance to AWWA C651, and applicable requirements of the Commonwealth of Virginia. No separate payment will be made for this item.
10. 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, between the hours of midnight and 4:00 AM. Flushing water will be based on a maximum of 8 HRS total. Any additional refilling or reflushing to be at the Contractor's expense at the Owner's commercial water rates.

END OF SECTION

SECTION 02724

DRAINAGE

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SECTION 02724

DRAINAGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
   1. Cleanouts.
   2. Drains.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. RCP: Reinforced concrete pipe.

C. HDPE: High density polyethylene pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Special pipe fittings.
   2. Drains.
   3. Channel drainage systems.
   4. Trench drains.

B. Shop Drawings: For the following:
   1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
   2. Catch Basins and Stormwater Inlets: Include plans, elevations, sections, details, and frames, covers, and grates.

C. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Engineer's or Owner's written permission.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 PVC PIPE AND FITTINGS

A. PVC Drainage Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Drainage Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1, 2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

C. PVC Profile Gravity Drain Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.3 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Drain Pipe and Fittings: ASTM C 14, Class 1, 2, and 3, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.

B. Reinforced-Concrete Drain Pipe and Fittings: ASTM C 76, with bell-and-spigot ends and gasketed joints with ASTM C 443, rubber gaskets.
   1. Class III, Wall A, B, and C.

2.4 CEMENT LINE CAST DUCTILE IRON PIPE

A. Pipe: Ductile Iron pipe, centrifugally cast, per ANSI Specification A21.51 (AWWA C151). Thickness Class 50 per ANSI Specification A21.50. Interior cement lining with bituminous seal coating per ANSI Specification 21.4. Exterior coating, bituminous coating per ANSI Specification A21.51 (AWWA C151).

B. Fittings: Fittings on drain lines shall be made with wye fittings. All ductile cast iron pipe and fittings shall be carefully checked and tested on the job for correct dimensions, coating and sand holes before placing pipe. All fittings shall conform to the requirements of ANSI A21.10.

C. Joints: Joints may be of a rubber (or synthetic rubber) gasket push-on type meeting all applicable requirements of ANSI A21.11 or Federal Specification WW-P-421C. Joints may be compression gasket per ASTM C-564-7-0.

D. Bedding: Shall be as shown in Standard Details of the Plans.

E. Pipe shall meet the requirements of ANSI/NSF Standard 61 for potable water.

2.5 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
   1. Drain Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC drain pipe fitting and riser to cleanout of same material as sewer piping. Provide cleanouts along new storm drain pipe at maximum spacing 75 ft.

PART 3 – EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 2 Sections "Earthwork for Utilities."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
   1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
      a. Unshielded flexible couplings for same or minor difference OD pipes.
      b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
      c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
   2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping and Subdrainage Piping: Use any of the following pipe materials for each size range and as noted on Plans:
   1. Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
   2. Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
   3. NPS 4 and NPS 6: PVC sewer pipe and fittings, gaskets, and gasketed joints.
   4. Retain one or more of 13 subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
   5. NPS 8 to NPS 12: PVC sewer pipe and fittings, gaskets, and gasketed joints.
   6. NPS 8 to NPS 12: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:
   1. of flow, at minimum slope of 2 percent, unless otherwise indicated.
   2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   3. Install piping below frost line.
   4. Install PVC drain piping according to ASTM D 2321 and ASTM F 1668.
   5. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.4 PIPE JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cement joints.
   2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
   3. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   4. Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
   5. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
   6. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.
   7. Join DI pipe materials with rubber o-ring gasket according to ANSI C-600.

C. Join dissimilar pipe materials with pressure-type couplings.

3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use light-duty, top-loading classification drains in earth or unpaved foot-traffic areas.
   2. Use medium-duty, top-loading classification drains in paved foot-traffic areas.
   3. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.
   4. Use extra-heavy-duty, top-loading classification drains in roads areas.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.7 IDENTIFICATION

A. Materials and their installation are specified in division 2 Section 02215 "Earthwork for Utilities" Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.8 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

SECTION 02741

HOT MIX ASPHALT PAVING

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SECTION 02741

HOT MIX ASPHALT PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes hot-mix asphalt paving, patching, and paving overlay.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Material certificates.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

B. Regulatory Requirements: Comply with VDOT Road & Bridge Specifications for asphalt paving work.

C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F (15.5 deg C).
   2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
   3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 – PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: In accordance with Sections 203 and 211 of the VDOT Road & Bridge Specifications.

B. Fine Aggregate: In accordance with Sections 202 and 211 of the VDOT Road & Bridge Specifications.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: In accordance with Section 210 of the VDOT Road & Bridge Specifications.

B. Tack Coat: In accordance with Section 310 of the VDOT Road & Bridge Specifications.

C. Prime Coat: Asphalt emulsion prime conforming to Section 3110F of the VDOT Road & Bridge Specifications requirements.

2.3 AUXILIARY MATERIALS

A. Pavement-Marking Paint: VDOT Type B, Class I, in accordance with Sections 246 and 704 of the VDOT Road & Bridge Specifications.

2.4 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by VDOT; designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
   1. Base Course: VDOT BM-25.0.
   2. Surface Course: VDOT SM-9.5A.

PART 3 – EXECUTION

3.1 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

C. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

3.2 SURFACE PREPARATION

A. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

B. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
   1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.10 to 0.15 gal./sq. yd. diluted in accordance with Section 310 of VDOT Road & Bridge Specifications.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference maximum theoretical density according to ASTM D 1559, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

F. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus 1/8 inch, no minus.
2. Surface Course: Plus 1/8 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/8 inch.
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.6 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.8 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION

SECTION 02890

SILTATION AND EROSION CONTROL

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SECTION 02890

SILTATION AND EROSION CONTROL

1.1 GENERAL

A. This Section shall consist of temporary control measures as directed by the Engineer's or the Owner's construction representative during the life of the Contract to control erosion and water pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.

B. This work shall be performed in accordance with the siltation and erosion control plan of the construction drawings and the details provided therein, and as described, detailed and required by the Virginia Soil and Water Construction Commission's most recent edition of the Virginia Erosion and Siltation Control Handbook.

C. The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features, to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

D. A detailed plan is shown in the appendix. The Contractor shall comply with the requirements of the local authority and provide a supplemental plan if required by that Authority. Contractor shall provide separate performance bond to local Authority.

E. The Contractor's on-site representative responsible for land disturbing and restoration activities shall be certified by the Virginia Department of Conservation and Recreation as a "Responsible Land Disturber." The Contractor shall comply with the Virginia Pollution Discharge Elimination System Permit issued by the Virginia Department of Conservation and Recreation and the storm water pollution prevention plan.

PART 2 – PRODUCTS

2.1 TEMPORARY SEEDING AND MULCHING

A. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion. A suitable seeding mixture shall be selected from the Handbook or as specified.

2.2 TEMPORARY BERMS

A. A temporary berm is constructed of compacted soil, with or without a shallow ditch, at the top of fill slopes or transverse to centerline on fills.

B. These berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

C. Temporary Slope Drains: A temporary slope drain is a facility consisting of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, sod or other material acceptable to the Engineer that may be used to carry water down slopes to reduce erosion. Sediment Structures: Sediment basins, ponds, and traps, are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the construction areas from excessive siltation.

2.3 CHECK DAMS

A. Check dams are barriers composed of logs and poles, large stones or other materials placed across a natural or constructed drainway.

B. Stone check dams shall not be utilized where the drainage exceeds 50 acres. Log and pole structures shall not be used where the drainage area exceeds five (5) acres.

2.4 BALED HAY OR STRAW CHECKS

A. Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing five (5) cubic feet or more of material.

B. Baled hay or straw checks shall be used where the existing ground slopes toward or away from the embankment along the toe of slopes, in ditches, or other areas where siltation erosion or water run-off is a problem.

2.5 TEMPORARY SILT FENCES

A. Silt fences are temporary measures utilizing woven wire or other approved material attached to posts with filter cloth composed of burlap, plastic filter fabric, etc., attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

PART 3 – EXECUTION

3.1 PROJECT REVIEW

A. During the pre-construction conference, the Contractor shall meet with the Engineer and go over in detail the expected problem areas in regard to the erosion control work. Different solutions should be discussed so that the best method might be determined. It is the responsibility of the Contractor to develop an erosion control plan acceptable to the Engineer.

B. Within 10 days after the pre-construction conference and prior to the start of any work, the Contractor shall submit for acceptance his schedule for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, bridges and other structures at watercourses, construction and paving. He shall also submit for acceptance his proposed method of erosion control on haul roads and borrow pits and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Engineer.

C. All disturbed areas that have no construction activity in close proximity shall be temporary seeded within 30 days of completion of the disturbing activities.

D. All siltation and erosion control devices installed during the course of construction shall be maintained in proper working order at all times, and shall not be removed until final stabilization of all disturbed areas or at the direction of the Engineer.

3.2 CONSTRUCTION REQUIREMENTS

A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other water impoundment. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds to the extent directed by the Engineer.

B. The Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practical time as outlined in his accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design state; that were needed prior to

installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise erosion control measures may be required between successive construction stages. Under no conditions shall the surface area of erodible earth material exposed at one time by clearing and grubbing, exceed 200,000 square feet without approval of the Engineer.

D. The Engineer will limit the area of excavation, borrow, and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such permanent pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

E. Under no conditions shall the amount of surface area or erodible earth material exposed at one time by excavation or fill within the project area exceed 200,000 square feet without prior approval by the Engineer.

F. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions.

G. In the event of conflict between these requirements and pollution control laws, rules or regulations, or other Federal, state or local agencies, the more restrictive laws, rules or regulations shall apply.

3.3 CONSTRUCTION OF STRUCTURES

A. Temporary Berms:
   1. A temporary berm shall be constructed of compacted soil, with a minimum width of 24 inches at the top and a minimum height of 12 inches with or without a shallow ditch, constructed at the top of fill slopes or transverse to centerline on fills.
   2. Temporary berms shall be graded so as to drain to a compacted outlet at the slope drain. The area adjacent to the temporary berm in the vicinity of the slope drain must be properly graded to enable this inlet to function efficiently and with minimum ponding in this area.
   3. All transverse berms required on the downstream side of a slope drain shall extend across the grade to the highest point at approximately a 10-degree angle with a perpendicular to centerline.
   4. The top width of these berms may be wider and the side slope flatter on transverse berms to allow equipment to pass over these berms with minimal disruptions. When practical and until final roadway elevations are approached, embankments should be constructed with a gradual slope to one side of the embankment to permit the placement of temporary berms and slope drains on only one side of the embankment.

B. Temporary Slope Drains:
   1. Temporary slope drains shall consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water accumulating in the cuts and on the fills down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.
   2. Fiber matting and plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.
   3. All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope

drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain. Energy dissipators, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipator would be dumped rock or a small sediment basin, which would slow the water as well as pick up some sediment. All temporary slope drains shall be removed when no longer necessary and the site restored to match the surroundings.

C. Sediment Structures:
   1. Sediment structures shall be utilized to control sediment at the foot of embankments where slope drains outlet; at the bottom as well as in the ditch lines atop waste sites; in the ditch lines or borrow pits.
   2. Sediment structures may be used in most drainage situations to prevent excessive siltation of pipe structures.
   3. All sediment structures shall be at least twice as long as they are wide.
   4. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed, and all excavation be restored to its natural or intended condition.

D. Check Dams:
   1. Check dams shall be utilized to retard stream flow and catch small sediment loads. Materials utilized to construct check dams are varied and should be clearly illustrated or explained in the Contractor's erosion control plan.
   2. All check dams shall be keyed into the sides and bottom of the channel a minimum depth of 2 feet. A design is not needed for check dams but some typical designs are shown in the standard plans.
   3. Stone check dams should generally not be utilized where the drainage area exceeds 50 acres. Log and pole structures should generally not be used where the drainage area exceeds five (5) acres.

E. Baled Hay or Straw Erosion Checks:
   1. Hay or straw erosion checks shall be embedded in the ground 4 to 6 inches to prevent water flowing under them. The bales shall also be anchored securely to the ground by wooden stakes driven through the bales into the ground.
   2. Bales can remain in place until they rot, or be removed after they have served their purpose, as determined by the Engineer.
   3. The Contractor shall keep the checks in good condition by replacing broken or damaged bales immediately after damage occurs.
   4. Normal debris clean-out will be considered routine maintenance.

F. Temporary Silt Fences:
   1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem.
   2. Silt fences are constructed of wire mesh fence with a covering of burlap or some other suitable material on the upper grade side of the fence and anchored into the soil.
   3. The Contractor shall be required to maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by the Engineer.
   4. The silt accumulation at the fence may be left in place and seeded, removed, etc., as directed by the Engineer.
   5. The silt fence becomes the property of the Contractor whenever the fence is removed.

G. Temporary Seeding:
   1. Establish temporary cover for erosion control by seeding and/or mulching graded areas which may otherwise be exposed for a period greater than 30 days. This should be accomplished as soon as rough grading work is done.
   2. On all steep slopes, where erosion is probable, hydroseed areas as soon as possible in strict accordance with applicable portions of Sections 244 and 607, seeding V.D.O.T. Road and Bridge Specifications. Maximum allowable slope to be seeded is 2:1.

H. Cleaning of Roads and Streets:
   1. The General Contractor shall maintain a vehicle wash rack or gravel bed according to the Handbook at all vehicle egress areas.
   2. All vehicles shall be thoroughly cleaned of mud and silt before leaving the construction site to avoid tracking mud and silt onto roads, streets, and highways. In the event that tracking does occur, the Contractor shall immediately clean the street or road of all debris, mud or silt and shall pay all damages resulting therefrom.
   3. A daily survey of the condition of the adjacent streets and roads shall be made and recorded in the field log along with daily cleanup of the streets of the tracking from the site onto roads, alleys, parking lots and highways.

3.4 MAINTENANCE

A. The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Contractor.

B. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled, and are ordered by the Engineer, such work shall be performed by the Contractor at his own expense.

C. Where the work to be performed is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls and falls within the specifications for a work item that has a contract price, the units of work shall be paid for at the proper contract prices.

D. Erosion Control Outside Project Area:
   1. Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads, and equipment storage sites.
   2. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed.

3.5 PERMITS

A. The Contractor shall be responsible for obtaining any required permits through the local DCR office or prevailing agency.

B. The Engineer will prepare the Erosion and Sediment Control Plan to be submitted for the permit.

C. Permit fees and bonds are the responsibility of the Contractor.

D. No separate pay item will cover this permit. The Contractor shall include payment in other contract items.

END OF SECTION

SECTION 03002

CONCRETE

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SECTION 03002

CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete and grout.
   2. Concrete mixes, proportioning, and source quality control for precast concrete.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 3 - Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. SP-19, Cement and Concrete Terminology.
      b. 211.1, Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete.
      c. 212.1R, Admixtures for Concrete.
      d. 212.2R, Guide for Use of Admixtures in Concrete.
      e. 214, Recommended Practice for Evaluation of Compression Test Results of Field Concrete.
      f. 301, Standard Specification for Structural Concrete.
      g. 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
      h. 304.2R, Placing Concrete by Pumping Methods.
      i. 305R, Hot Weather Concreting.
      j. 306R, Cold Weather Concreting.
      k. 318, Building Code Requirements for Reinforced Concrete.
      l. 347, Recommended Practice for Concrete Form work.
   2. American Society for Testing and Materials (ASTM):
      a. A82, Standard Specifications for Cold Drawn Steel Wire for Concrete Reinforcement.
      b. A185, Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
      c. A615, Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement Including Supplementary Requirements S1.
      d. C31, Standard Method of Making and Curing Concrete Test Specimens in the Field.
      e. C33, Standard Specification for Concrete Aggregates.
      f. C39, Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens.
      g. C94, Standard Specification for Ready Mixed Concrete.
      h. C138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
      i. C143, Standard Method of Test for Slump of Portland Cement Concrete.
      j. C150, Standard Specification for Portland Cement.
      k. C157, Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
      l. C171, Standard Specification for Sheet Materials for Curing Concrete.
      m. C172, Standard Method of Sampling Fresh Concrete.
      n. C173, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
      o. C192, Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.
      p. C231, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
      q. C260, Standard Specification for Air Entraining Admixtures for Concrete.
      r. C289, Test Method for Potential 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, Specification for Blended Hydraulic Cements.
v. C618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
w. D1056, Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
x. E329, Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

3. Federal Specification (FS):
   a. TT-S-227b, Sealer Compound; Rubber Base, Two Component.
   b. LLL-B-810B, Building Board, (Hardboard) Hard Pressed, 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.

C. Qualifications: Ready mixed concrete batch plant certified by National Ready Mixed Concrete Association (NRMCA).

1.3 DEFINITIONS

A. Per ACI SP-19 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 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
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. Proportioning of all materials.
   c. Type of cement with mill certificate for cement.
   d. Type of fly ash with certificate of conformance to specification requirements.
   e. Slump.
   f. Air content.
   g. Brand, type, ASTM designation, manufacturer's product sheet and quantity of each admixture proposed for use.
   h. 28-day cylinder compressive test results of trial mixes per ACI 318 and as indicated herein.
   i. Standard deviation value for concrete production facility.
   j. Test for aggregate organic impurities.
   k. Test for deleterious aggregate per ASTM C289.
3. Manufacturer and type of joint filler, joint sealant, and curing agent.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:
1. Cement and fly ash:
    a. Store in moistureproof, weather tight 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 delivery ticket for each load for ready-mixed concrete.
    b. Truck operator shall hand ticket to Testing Agent at the time of delivery.
    c. Ticket to show:
        1) Mix identification mark.
        2) Quantity delivered.
        3) Amount of each material in batch.
        4) Outdoor temp in the shade.
        5) Time at which water was added.
        6) Numerical sequence of the delivery.
        7) Amount of water added.
2. Reinforcing steel: Ship to job site 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. Gifford Hill "Supreme Grout."
    c. Master Builders "Masterflow 713."
    d. Or approved equal.
2. Expansion joint fillers:
    a. Permaglaze Co.
    b. Rubatex Corp.
    c. Williams Products, Inc.
    d. Or approved equal.
3. Waterstops:
    a. PVC Bulb-type:

1) Greenstreak Plastics Products.
2) Vinylex Corporation.
3) Burke Company.
4) Or approved equal.

b. Strip-type:
1) Greenstreak Plastics Products.
2) Henry.
3) Adeka.
4) Or approved equal.

c. Paste-type:
1) Adeka.
2) Vinylex Corporation.
3) Or approved equal.

4. Form coating:
a. Richmond "Rich Cote."
b. Industrial Lubricants "Nox-Crete Form Coating."
c. Protex "Pro-Cote."
d. Or approved equal.

5. Prefabricated forms:
a. Simplex "Industrial Steel Frame Forms."
b. Symons "Steel Ply."
c. Universal "Uniform."
d. Or approved equal.

2.2 MATERIALS

A. Portland Cement: Conform to ASTM C150 Type I/II

B. Fly Ash:
1. ASTM C618, Class F.
2. Nonstaining.
3. Hardened concrete containing fly ash to be uniform light gray color.
4. Maximum loss on ignition: 3 percent for air entrained concrete, 6 percent otherwise.
5. Compatible with other concrete ingredients.
6. Obtain proposed fly ash from a source approved by the State Highway Department in the state where the Project is located for use in concrete for bridges.
7. Do not use for precast 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 212.1R and ACI 212.2R.
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.
a. 0.06 prestressed concrete.
b. 0.10 all other concrete.
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 Grount:
   a. 3 component epoxy resin system.
      1) Two liquid epoxy components.
      2) One inert aggregate filter component.
   b. Each component packaged separately for mixing at job site.

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. Plywood: PS1, waterproof, resin bonded, exterior-type Douglas Fir.
   a. Face adjacent to concrete Grade B or better.
3. Fiberboard: Fed Specification LLL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard.
4. Lumber: Straight; uniform width and thickness; and free from knots, offsets, holes, dents, and other surface defects.
5. Chamfer strips: Clear white pine, surface against concrete planed.
6. Form release: Non-staining and shall not prevent bonding of future finishes to concrete surface.
7. Form ties: Removable end, permanently embedded body type with cones on outer ends not requiring auxiliary spreaders.
   a. Cone diameter ¾" MIN and 1" MAX.
   b. Embedded portion 1" MIN back from concrete face.
   c. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.

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. Liquid Chemical Floor Hardener:
1. Colorless, aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent.
   a. Not less than 2 LB fluorosilicate per gallon.
2. Provide material which does not react with, inhibit, or otherwise interfere with adhesives and bonding of future floor finishes.

K. Membrane Curing Compound: ASTM C309, Type I-D.
1. Resin based, dissipates upon exposure to UV light.
2. Curing compound shall not interfere with liquid floor hardener or prevent bonding of any future coverings, coatings or finishes.

L. Waterstops, Bulb Type:
1. Materials:
   a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or pigment.
   b. Corps of Engineers Specification CRD-C572.

2. In construction joints joints:
   a. 6 IN wide x 3/8 IN thick bulb type.
   b. Similar to Greenstreak Plastics Products Style #705.
   c. Manufactured solely for the purpose of preventing water from traveling through construction joints.

M. Waterstops, Preformed - Strip Type:
1. Non-swelling Type
   a. Manufactured solely for the purpose of preventing water from traveling through construction joints.
   b. Non-swelling type only.
2. Swelling Type (Hydrophilic)
   a. Manufactured solely for the purpose of preventing water from traveling through construction joints.
   b. Bentonite (clay) based products are not permitted.
3. Liquid/Paste Type (Hydrophilic)
   a. Manufactured solely for the purpose of preventing water from traveling through construction joints.

2.3 CONCRETE MIXES

A. General:
1. All concrete to be ready mixed concrete conforming to ASTM C94.
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 except where lightweight concrete is indicated on Drawings.

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
Lean Concrete	Normal Weight	3000 psi
All Other 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:

Maximum Aggregate Size	Total Air Content Percent
1 IN or 3/4 IN	5 to 7
1/2 IN	6 to 8

1. Air content to be measured in accordance with ASTM C231, ASTM C173, ASTM C138.

D. Slump: 4 IN maximum.
1. Measured at point of discharge of the concrete into the concrete construction member.
2. 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.
3. 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. Substitution of fly ash:
   a. Maximum of 15 percent by weight of cement at rate of 1 LB fly ash for 1 LB of cement.
3. 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.
f. Adjust mix to obtain satisfactory finishing.

4. Submit mix design data as required by this specification section, ACI 301, and ACI 318.
5. 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.
6. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of paragraph 5.3 of ACI 318 using the standard deviation of the proposed concrete production facility as described in paragraph 5.3.1 of ACI 318.

7. Minimum cement contents and maximum water cement ratios for concrete to be as follows:

Specified Strength	Minimum Cement, LB/CY			Maximum Water Cement Ratio by Weight
	Maximum, 1/2	Aggregate, 3/4	Size, IN 1	
3000	---	517	517	0.45
4000	611	611	611	0.45
5000	---	686	665	0.40

PART 3 – EXECUTION

3.1 FORMING AND PLACING CONCRETE

A. General:
   1. Contractor is responsible for design and erection of form work.
   2. Construct form work 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 or elevated floor slabs to drains.
      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.
   4. Allow Engineer to inspect form and reinforcement prior to pour, when all trade work is complete.

B. Openings: Provide openings in form work 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. Reinforcement:
   1. Position, support and secure reinforcement against displacement.
   2. Locate and support with chairs, runners, bolsters, spacers and hangers, as required.
   3. Set wire ties so ends do not touch forms and are directed into concrete, not toward exposed concrete surfaces.
   4. Lap splice lengths: ACI 318 Class B, Case 2, "other bar" tension splices unless indicated otherwise on the Drawings.
   5. Extend reinforcement to within 2 IN of concrete perimeter edges.
      a. If perimeter edge is earth formed, extend reinforcement to within 3 IN of the edge.
   6. Do not weld reinforcing bars.
   7. Welded wire fabric:
      a. Install welded wire fabric in maximum practical sizes.

b. Splice sides and ends with a splice lap length measured between outermost cross wires of each fabric sheet not less than:
   1) One spacing of cross wires plus 2 IN.
   2) 1.5 x development length.
   3) 6 IN.
c. Development length: ACI 318 basic development length for the specified fabric yield strength.

E. Construction, Expansion, and Contraction Joints:
1. Provide at locations indicated.
2. Locate wall vertical construction joints at 30 FT maximum centers and wall horizontal construction joints at 10 ft. maximum centers.
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.

F. 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.

G. 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.

H. Placing Concrete:
1. Place concrete in compliance with ACI 304 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.

I. 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.

J. Protection:
1. Protect concrete from physical damage or reduced strength due to weather extremes.
2. In cold weather comply with ACI 306R 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°F	70°F
Between 30 to 45°F	60°F
Above 45°F	50°F

   c. Do not place heated concrete that is warmer than 80°F.
   d. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50°F for 7 days or 70°F for 3 days.
   e. Do not allow concrete to cool suddenly.
3. In hot weather comply with ACI 305R except as modified herein.
   a. At air temperature of 90°F and above, keep concrete as cool as possible during placement and curing.
   b. Do not allow concrete temperature to exceed 70°F 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 305R, Figure 2.1.5.

K. 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 305R.
7. In cold weather follow curing procedures outlined in ACI 306R.
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: Cover vertical surfaces with a minimum of two coats of the curing compound.
   a. Allow the preceding coat to completely dry prior to applying the next coat.
   b. Apply the first coat of curing compound immediately after form removal.
   c. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
   d. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

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. Grout Cleaned Finish:

1. Mix a part Portland cement and 1½ parts fine sand with sufficient bonding agent/water mixture to produce a grout with the consistency of thick paint.
   a. White Portland cement shall be substituted for gray Portland cement to produce a color that matches color of surrounding concrete as determined by trial patch for areas not to be painted.
2. Wet surface of concrete to prevent absorption of water by grout and uniformly apply grout with brushes or spray gun.
3. Immediately scrub the surface with a cork float or stone to coat and fill air bubbles and holes.
4. While grout is still plastic, remove all excess grout by working surface with rubber float, sack or other approved means.
5. After the surface whitens from drying, rub vigorously with clean burlap.
6. Keep final finish damp for a minimum of 36 HRS after final rubbing.

E. Slab Float Finish:

1. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
2. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operation.

3. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
4. Cut down all high spots and fill all low spots during this procedure to produce a surface within Class B tolerance throughout.
5. Refloat slab immediately to a uniform sandy texture.

F. Troweled Finish:
1. Float finish surface.
2. Next power trowel, and finally hand trowel.
3. Produce a smooth surface which is relatively free of defects with first hand troweling.
4. Perform additional trowelings by hand after surface has hardened sufficiently.
5. Final trowel when a ringing sound is produced as trowel is moved over surface.
6. Thoroughly consolidate surface by hand troweling.
7. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
8. On surfaces intended to support floor coverings remove any defects of sufficient magnitude that would show through floor covering by grinding.

G. Broom Finish: Immediately after concrete has received a float finish as specified above, give it a transverse scored texture by drawing a broom across surface.

H. Apply chemical floor hardener to permanently exposed interior concrete floor slab surfaces.
1. Apply in accordance with manufacturer's instructions.

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. Nonshrinking 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 base plates.
e. Provide forms where base plates and bed plates 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, bed plate, 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.

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. Four cylinders, 4 IN DIA x 8 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.
3) One spare.
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, 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.

3.5 SCHEDULES

A. Form Types:
1. Surfaces exposed to view:
   a. Prefabricated plywood panel forms, job-built plywood forms, or forms lined with plywood or fiberboard.
   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 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
3. Sand cement grout.

C. Concrete:
1. Concrete fill: Where indicated on Drawings.
2. Normal weight concrete: All other locations.
3. Precast concrete: Where indicated on Drawings.
4. Lean Concrete: Duct banks, suggest normal 4000 psi concrete be used here and when indicated on Drawings.

D. Concrete Finishes:
1. Grout cleaned finish: Exposed vertical concrete surfaces.
2. Slab finishes:
   a. Use following finishes as applicable, unless otherwise indicated:
      1) Troweled finish: All interior floor surfaces.
      2) Broom finish: Sidewalks, concrete stairs, ramps, containment area, and exterior walking surfaces.

END OF SECTION

SECTION 03360

CONCRETE INJECTION REPAIR

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SECTION 03360

CONCRETE INJECTION REPAIR

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete crack repair by injection methods.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 3 - Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 503.7, Specification for Crack Repair by Epoxy Injection.

B. Quality Control:
      a. Qualifications: Chemical manufacturer shall have a minimum of 5 years producing chemicals being applied for the specifically intended purpose.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 – *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Applicator's qualifications.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendations for crack/joint preparation.
   4. Warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:
   1. Injection chemicals and components:
      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.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Hydrophobic Injection Materials:
      a. Emecole.
      b. Sika.
      c. Prime Resins.
      d. Webac.
      e. Or approved equal.

2.2 MATERIALS

A. Hydrophobic Injection Materials:
   1. Either one-part or two-part polyurethane based.
   2. Cure/Gel time: < 2 minutes. Accelerant additives are permitted based on specific installations and as approved by Engineer.
   3. Suitable for installation in actively flowing cracks/joints.
   4. If concrete is in contact with process water, use NSF-61 certified product.

PART 3 – EXECUTION

3.1 PREPARATION

A. Contractor is responsible for properly preparing cracks and joints to be sealed in accordance with manufacturer's written instructions.

B. Clean surfaces as necessary to determine extent of cracking to determine the best location for the installation of injection ports.

3.2 INSTALLATION

A. Injection ports.
   1. Before drilling injection holes to receive injection ports, locate rebar and conduit, and plan the pattern to minimize unnecessary damage during drilling.
   2. Select the proper size bit for the appropriate size injection port and injection pressure as recommended by the manufacturer.
   3. Space the injection port holes based on crack width, length of crack, and manufacturer's recommendations.
   4. The angle while drilling should be approximately 45 degrees to the surface towards the crack and intersecting the crack.
   5. The drilled hole should intersect the crack approximately midway through the structure, but need not exceed 18".
   6. Angle drilling on structures less than 6" thick is not allowed. In these instances, drill perpendicular to the structure directly into the crack to mid-depth.
   7. Install mechanical injection ports based on manufacturer's written instructions.

B. Resin Injection.
   1. Determine injection port order based on crack width and manufacturer's suggestions.
   2. Flush crack with water prior to injecting resin as recommended by the manufacturer.
   3. Monitor pressure on the injection line and the injection line itself to ensure that resin is properly being injected.
   4. Monitor and observe adjacent ports and cracks for the discharge of free water, water/resin mixture, and pure resin as and indicator that the resin is completely filling the crack/joint.

C. Clean-up.
   1. Clean up excess resin prior to final set. Chipping, grinding, and other mechanical means are prohibited.

END OF SECTION

SECTION 03431

PRECAST AND PRESTRESSED CONCRETE

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SECTION 03431
PRECAST AND PRESTRESSED CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast and prestressed concrete.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete.*
   4. Section 09905 - *Painting and Protective Coatings.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 318, Building Code Requirements for Structural Concrete.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
      c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
      d. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
      e. C33, Standard Specification for Concrete Aggregates.
      f. C150, Standard Specification for Portland Cement.
      g. C330, Standard Specification for Lightweight Aggregates for Structural Concrete.
      h. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
   3. American Welding Society (AWS):
      a. A5.1, Standard Specification for Mild Steel Covered Arc-Welding Electrodes.
      b. A5.5, Standard Specification for Low-Alloy Steel Covered Arc-Welding Electrodes.
      c. D1.1, Structural Welding Code, Steel.
      d. D1.4, Structural Welding Code, Reinforcing Steel.
   4. Prestressed Concrete Institute (PCI):
      a. MNL-116, Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.
      b. PCI Design Handbook Precast and Prestressed Concrete.

B. Qualifications:
   1. Provide precast and prestressed concrete units produced by an active member of Prestressed Concrete Institute (PCI).
   2. Provide units manufactured by plant which has regularly and continuously engaged in manufacture of units of same type as those required for a minimum of 3 years.
   3. Assure manufacturer's testing facilities meet requirements of ASTM E329.
   4. Welding operators and processes to be qualified in accordance with:
      a. AWS D1.1 for welding steel shapes and plates.
      b. AWS D1.4 for welding reinforcing bars.
   5. Welding operators to have passed qualification tests for type of welding required during the previous 12 months prior to commencement of welding.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:

a. Acknowledgment that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Sizes, types and manufacturer of bearing pads.
d. Hardware to be utilized to support suspended appurtenances.

3. Shop drawings and erection plans for precast units, their connections and supports showing:
   a. Member size and location.
   b. Size, configuration, location and quantity of reinforcing bars and prestressing strands.
   c. Initial prestress forces.
   d. Size and location of openings verified by Contractor.
   e. Size, number, and locations of embedded metal items and connections.
   f. Required concrete strengths.
   g. Identification of each unit using same standard marking numbers as used to mark actual units.
4. Calculations for members and connections designed by fabricator. Calculations to be sealed by a professional engineer registered in the State of Nebraska. Perform calculations using the dead load of the members plus the superimposed uniform and concentrated loads shown on the Drawings and indicated in this Specification Section. Indicate the following:
   a. Design for maximum moment, maximum shear and maximum torsion.
   b. Final top and bottom flexural stresses resulting from the stresses due to maximum moment and prestress force.
   c. Ultimate moment capacity.
   d. Final top and bottom flexural stresses, ultimate moment capacity, and ultimate shear capacity, if affected, for members with reduced cross sections due to openings or penetrations.
   e. When required on Drawings, a check for no tension in top and bottom of members due to prestress force and member dead load plus superimposed loads indicated on Drawings and in this Specification Section.
   f. Column design for maximum axial load and maximum moment.
5. Concrete mix design(s) including submittal information defined in Section 03350 - Testing.
6. Copies of source quality control tests.
7. Certification of manufacturer's testing facility qualifications.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Division: TRW, Inc.
      b. KSM Division, Omark Industries.
      c. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Embedded Steel Plates and Shapes: ASTM A36.

B. Bearing Pads:
   1. Neoprene or RFRE, in accordance with PCI Design Handbook.

C. Cement:
   1. Comply with ASTM C150, Type I or III.

D. Aggregates for Normal Weight Concrete:
   1. ASTM C33 with coarse aggregate meeting the gradation for size 67 as stated in ASTM C33.
   2. Provide aggregates approved for bridge construction by the State Highway Department in the state where the precast units are fabricated or in the state where the Project is located.
   3. All fine aggregate to be natural not manufactured.

E. Water:
   1. Potable, clean.

2. Free of oils, acids, and organic matter.

F. Maximum total chloride ion content contributed from all ingredients of concrete including water, aggregates, cement and admixtures measured as a weight percent of cement to not exceed 0.06 for prestressed concrete and 0.10 for all other precast concrete.

G. Prestressing Strands:
1. Either 250K or 270K high tensile strength uncoated seven-wire strand, stress relieved as a unit after wires have been formed into a strand.
2. Manufacture and test strands in accordance with ASTM A416.

H. Reinforcing Steel and Welded Wire Fabric: See Section 03208 - *Reinforcement*.

I. Headed Studs:
1. ASTM A108.
2. Minimum yield strength: 50,000 psi.
3. Minimum tensile strength: 60,000 psi.

J. Deformed Bar Anchors:
1. ASTM A496.
2. Minimum tensile strength: 80,000 psi.
3. Minimum yield strength: 70,000 psi.

K. Electrodes:
1. E70 series conforming to AWS A5.1 or A5.5 for welding steel shapes and plates.
2. E90 series conforming to AWS A5.5 for welding rebar.

L. Concrete sand cement grout in key ways between hollow core slabs. See Section 03208 - *Reinforcement*.

2.3 MIXES

A. See Section 03308 - *Concrete Materials and Proportioning*.

B. Do not begin fabrication of units until concrete mix design(s) have been approved by Engineer.

2.4 DESIGN

A. General Design Requirements:
1. Design units and connections in strict accordance with ACI 318 and the PCI Design Handbook Precast and Prestressed Concrete.
2. Design units for spans, dead load of members, dead and live loads indicated on the Drawings with concentrated loads placed in their actual locations. Verify weights and locations of concentrated loads.
3. Design units taking into account reduced cross section at openings and penetrations.
4. Provide all reinforcing in units as indicated. Where not indicated, design and provide all reinforcing and prestressing strands subject to approval of Engineer.

2.5 FABRICATION

A. Do not fabricate units until shop drawings have been approved by Engineer and returned to Contractor and support locations have been field verified by Contractor.

B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with both PCI MNL-116 and PCI Design Handbook Precast and Prestressed Concrete.

C. Cast all members in smooth rigid forms which will provide straight, true members of uniform thickness and uniform color and finish. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.

D. Finish all repairs smooth and to match adjacent surface texture and color.

E. Incorporate embedded plates, angles, and flange welding strips into members at time of manufacture. Provide embedded items as shown on the Drawings unless prior approval is received from Engineer to do otherwise.
   1. Provide manufacturer's standard flange welding strips provided such welding strips are approved by Engineer.
   2. Provide welding strips on all flange edges of all double tee units.
   3. Space strips as shown on Drawings.
   4. Cast lifting handles into units at or near support points. Remove lifting handles after units are erected.

F. Cast openings larger than 6 IN SQ or 6 IN DIA in units at time of manufacture. Make smaller openings by neat cutting or neat drilling by trades requiring them. Coordinate sizes and locations of all openings before fabrication of units.

G. Make provisions for support of suspended ceilings, lighting fixtures, ducts, piping, conduits and other suspended work.
   1. When drilled expansion bolts or powder-driven fasteners are approved for use, coordinate prestress strand location with prestress concrete member supplier so that drilled expansion bolts or powder-driven fasteners do not hit or are drilled or driven into prestress strands.
   2. Install powder-driven fasteners by means of a low velocity powder-actuated tool complying with requirements of OSHA.
      a. Assure that the load to be supported by each in place drilled expansion bolt or powder-driven fastener does not exceed the maximum allowable load recommended by the bolt or fastener manufacturer for the concrete strength encountered and for the type, size and embedment length of expansion bolt or driven fastener installed.

H. Automatically weld headed studs and deformed bar anchors to members to provide full penetration weld between studs, bar anchors and members they are attached to.

I. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.

J. Minimum concrete compressive strength at time of strand release: 3500 psi.

K. Mark each unit as indicated on the erection plans. Place mark on non-exposed-to-view surface.

L. Coat or finish ends of exposed prestressing strands to prevent rusting.

M. Fabricate the following types of precast and prestressed units (all units to be made with normal weight concrete unless noted otherwise on Drawings):
   1. Prestressed hollow core slabs of sizes indicated. Weight of hollow core slabs not to exceed the following:

Depth	Normal Weight Concrete
6 IN	49 psf
8 IN	56 psf
10 IN	68 psf
12 IN	68 psf

   2. Precast lintels as shown on Drawings.

2.6 SOURCE QUALITY CONTROL

A. During production of precast concrete units, conduct strength tests of concrete placed in units as required in Specification Section 03350 - Testing, for concrete placed during fabrication. Results of strength tests to be sent immediately to Engineer, Contractor and Owner. Test reports to indicate units they represent.

B. When approved by Engineer, strength tests may be made by precast manufacturer after certification has been submitted that testing facilities meet the requirements of ASTM E329.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify acceptability and location of supports to receive units. Check bearing surfaces to determine that they are level and uniform.

B. Verify compressive strengths of concrete and masonry supports. Do not start erection of units until supports have reached their 28-day required compressive strengths.

3.2 INSTALLATION

A. Sequence erection to provide a balance of loads across beams and columns.

B. Give consideration to possible lack of stability or capacity of partially completed frame or structure.

C. Contractor to be responsible for guying, shoring, and bracing of frame, walls and individual members as necessary to resist forces due to wind, erection, or any other source that may occur before structure is completed.

D. Use only erection equipment adequate for placing units at lines and elevations indicated on Drawings. Do not damage units or existing construction during erection. Erect units using lifting handles cast into the units.

E. Place hollow core slabs on continuous ¼ IN thick neoprene bearing pad whose width to equal bearing length -1 IN.

F. After erection, verify that there is no direct contact between bottom of units and supporting members, except for bridge sections and lintels. Where direct contact occurs, install additional layers of bearing material to raise units off supports.

G. Lintels:
   1. Length of lintel bearing on supports to be as indicated on Drawings. If not indicated, minimum length of lintel bearing to be 8 IN.
   2. Fill masonry cells under lintel bearing with masonry grout and reinforce to match wall reinforcing, #4 min.
   3. Provide minimum 3/8 IN thick full bed joint of masonry mortar between underside of lintel and top surface of grouted masonry for complete lintel bearing length.

H. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.

I. Fill all key ways between hollow core slabs with concrete sand cement grout. See Section 03308 - *Concrete Materials and Proportioning.*

3.3 FIELD QUALITY CONTROL

A. Causes for rejection of units include, but are not necessarily limited to the following:
   1. Cracked units.
   2. Chipped, broken, or spalled edges.
   3. Units not within allowable casting tolerances.
   4. Voids or air pockets which, in opinion of Engineer, are too numerous or too large.
   5. Non-uniform finish or appearance.
   6. Low concrete strength.
   7. Improperly placed embedded items and/or openings.
   8. Exposed wire mesh, reinforcing or prestressing strands.

END OF SECTION

SECTION 04050

COLD WEATHER PROTECTION

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SECTION 04050

COLD WEATHER PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cold- weather protection.

B. Related Sections include (but are not necessarily limited to):
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. International Masonry Industry All-Weather Council:
      a. Recommended Practices and Guide Specifications for Cold- Weather Masonry Construction.

PART 2 – PRODUCTS - NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 ERECTION AND APPLICATION

A. General:
   1. Do not use frozen or ice- coated materials.
   2. At the end of each day or at shutdown, cover tops of all walls not enclosed or sheltered, with clean polyethylene minimum 6 mil thick. Extend down each side of wall a minimum of 16 IN.

B. Temporary Facilities:
   1. Construct and maintain temporary protection required to permit continuous and orderly progress of work.
   2. Provide and maintain heat sufficient to assure temperature above 32°F within protected areas.
   3. Remove all temporary facilities after completion of work.

C. Procedures Prior to and During Installation:
   1. Air temperature: 32°F to 40°F.
      a. Heat mixing water or aggregate to produce mortar temperatures between 40°F and 120°F.
   2. Air temperature: 25°F to 32°F.
      a. Heat mixing water or aggregate to produce mortar temperatures between 40°F and 120°F.
      b. Maintain mortar temperatures above freezing until used.
   3. Air temperature: Below 25°F.
      a. Heat mixing water and aggregate to produce mortar temperatures between 40°F and 120°F.
      b. Maintain mortar temperatures above freezing until used.
      c. Maintain temperature of units until laid at not less than 20°F.
      d. Provide heat on both sides of walls under construction to maintain air temperature above freezing.
      e. Provide windbreaks or shelters when wind is in excess of 15 mph.
         1) Wind breaks or shelters shall be translucent.

D. Procedures after Installation:
   1. Air temperature: 32°F to 40°F.
      a. Protect from rain or snow for not less than 24 HRS by covering with weather-resistive translucent membrane.
   2. Air temperature: 25°F to 32°F.
      a. Completely cover with translucent weather-resistive membrane for not less than 24 HRS.
   3. Air temperature: 20°F to 25°F.
      a. Completely protect with insulating blankets for not less than 24 HRS or provide other protection approved by Engineer.
   4. Air temperature: Below 20°F.
      a. Provide enclosed translucent shelters and heating to maintain air temperature on each side of wall above 32°F for 24 HRS.
      b. Do not allow rapid drop in temperature after removal of heat.

END OF SECTION

SECTION 04110

CEMENT AND LIME MORTARS

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SECTION 04110

CEMENT AND LIME MORTARS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cement and lime mortars and general purpose grout.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 – *Concrete*.
   4. Section 04220 - *Concrete Masonry*.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C144, Standard Specification for Aggregate for Masonry Mortar.
      b. C150, Standard Specification for Portland Cement.
      c. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
      d. C270, Standard Specification for Mortar for Unit Masonry.
      e. C404, Standard Specification for Aggregates for Masonry Grout.
      f. C476, Standard Specification for Grout for Masonry.
      g. C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
      h. C1019, Standard Test Method for Sampling and Testing Grout.

1.3 DEFINITIONS

A. Coarse grout and fine grout are defined by the aggregate size used in accordance with ASTM C476.

B. Coarse aggregate and fine aggregate are defined in ASTM C404, Table 1.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals*.
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Mortar mix design.

B. Samples:
   1. Colored mortar samples for color selection by Engineer.

C. Miscellaneous Submittals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals*.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Portland Cement:
   1. ASTM C150, Type I.
   2. No air entrainment.
   3. Natural color.

4. Maximum percent of alkalies: 0.60 in accordance with ASTM C150, Table 2.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Aggregate: ASTM C144, free of gypsum.

D. General Purpose Grout: ASTM C476.

E. Grout Aggregate: ASTM C404.

F. Water: Potable.

G. Mortar Pigments:
1. Commercial colorants suitably compounded for use in mortar mixes. Do not exceed manufacturer's recommended pigment-to-cement ratios.

2.2 MIXES

A. Type S mortar:
1. Comply with ASTM C270.
2. Do not use masonry cement.
3. Mix materials minimum of three (3) minutes.
4. Adjust consistency to satisfaction of mason.
5. Use no anti-freeze additives.

B. General Purpose Grout:
1. Comply with ASTM C476, Table 1.
2. Use no anti-freeze additives.
3. Mix five (5) minutes minimum.
4. Slump: 8 IN to 10 IN.
5. At Contractor's option, manufactured grout may be used. Section 03002 - *Concrete*.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Use coarse grout in spaces with least dimension over 2 IN.

C. Use fine grout for grouting door frames in masonry.
1. Grout all door frames in masonry.

D. Consolidate all grout while installing.

3.2 FIELD QUALITY CONTROL

A. If mortar begins to stiffen within 2½ HRS, it may be retempered by adding water and remixing.

B. Do not use mortar after it has begun to set. No mortar shall be used beyond 2½ HRS after initial mixing.

C. Use grout within 2 HRS after initial mixing. Use no grout after it has begun to set.

D. Verify all exterior joints in prefaced masonry units have been raked out to required depth.

END OF SECTION

SECTION 04155

MASONRY ACCESSORIES

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SECTION 04155

MASONRY ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Masonry accessories.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 04220 - *Concrete Masonry.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
      b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. D226, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
      d. D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
      e. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
      f. D2000, Standard Classification System for Rubber Products in Automotive Applications.
      g. D2287, Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

B. Coordinate with built-in items and veneer coursing.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Tear resistance of flashing material.
      d. Manufacturer's recommendations for flashing adhesive.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Weeps and vents for cavity wall construction:
      a. AA Wire Products Co.
      b. Dur-O-Wal, Inc.
      c. Heckman Building Products, Inc.
      d. Williams Products, Inc.
      e. Or approved equal.
   2. Reglets:
      a. Fry Reglet Corp.
      b. W.P. Hickman Co.
      c. Or approved equal.
   3. Masonry anchors and horizontal joint reinforcing:
      a. Hohmann & Barnard.
      b. Dur-O-Wall Inc.
      c. Heckman Building Products Inc.

d. Ivy Steel & Wire.
e. Wire-Bond.
f. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitutions*.

2.2 MATERIALS

A. Flashing:
1. Minimum 30 mil EPDM.
2. Tear resistance: ASTM D624, 175 LB/IN minimum.
3. Width as required.
4. Factory precut wherever possible.

B. Flashing Adhesive: As recommended by flashing manufacturer for sealing laps and sealing to vertical surfaces.

C. Weep Inserts for cavity wall construction:
1. Drains: Plastic or aluminum louvered type vent designed to be placed in vertical mortar joint near bottom of wall. Provide with rectangular horizontal mortar guard to prevent mortar droppings from filling joint behind vent.
2. Drains: Plastic or aluminum louvered type vent designed to be placed in vertical mortar joint near top of wall. Provide with rectangular horizontal mortar guard to prevent mortar droppings from filling joint behind vent.
3. Similar to Hohmann & Barnard, Inc., #343 louvered weep hole.

D. Reglets: Aluminum or non-ferrous.

E. Horizontal Joint Reinforcing:
1. Cold drawn steel wire, ASTM A82.
2. 9 GA side rods.
3. 9 GA cross rods.
4. Galvanized, ASTM A153.
5. Units similar to Dur-O-Wal "Ladur-Eye" at cavity walls.
6. Truss design at single wythe walls.
7. Prefabricated corner and tee sections with minimum length of 32 IN from point of intersection.

F. Preformed Control Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
1. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation 2AA-805.
2. Polyvinyl Chloride: ASTM D 2287, General Purpose Grade, Type PVC-65406.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Thru Wall Flashing:
1. Install to provide positive drainage of cavity moisture.
2. Place flashing on bed of mortar before covering with mortar.
3. Extend flashing minimum 1/2 IN beyond the exterior face of the wall. After wall construction is completed cut flashing to within 1/8 IN from face of wall to form a drip.
4. Extend flashings beyond edge of lintel or sills to next vertical mortar joint but not less than 4 IN and turn up edge one full course.
5. Lap flashing minimum of 6 IN and bond two (2) pieces together with flashing adhesive.
6. Install upper edge of flashing into block joint for new construction or into reglet with adhesive for retrofit work.

C. Weeps:
1. Install draining weeps maximum 32 IN OC in head joint of first course of masonry immediately above through wall flashing.
a. At door openings, install weeps on each side of opening. Do not install weeps above door openings.

b. At openings other than doors, weeps may be installed above opening if required by spacing pattern.

2. Install venting weeps maximum 33 IN OC in head joint of top course of masonry or as indicated on Drawings.

D. Reinforcing Brick Veneer:

1. Brick veneer with concrete masonry back-up: Anchor veneer to back-up using horizontal joint reinforcing at 16 IN OC vertically.
2. Coordinate continuous joint reinforcement with backer material to provide required reinforcement.
   a. Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8 IN on exterior side of walls and 1/2 IN at other locations.
   b. Lap reinforcement minimum of 6 IN at ends.
   c. Do not bridge control and expansion joints with reinforcing except at wall openings.
   d. Make corners and wall intersections by use of prefabricated "L" and "T" sections.
   e. Cut and bend units as required.
   f. Install horizontal joint reinforcing 8 IN OC in starter courses, over openings and in parapets.
3. Reinforce masonry openings over 12 IN wide, with horizontal joint reinforcing placed in two horizontal joints above lintel and below sill.
   a. Extend reinforcing minimum of 24 IN beyond jambs of opening.
4. Do not bridge control joints where provided.

E. Reinforcing Concrete Masonry:

1. Provide continuous horizontal joint reinforcing.
   a. Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8 IN on exterior side of walls and 1/2 IN at other locations.
   b. Lap reinforcement minimum 6 IN at ends.
   c. Do not bridge control and expansion joints with reinforcing except at wall openings.
   d. Make corners and wall intersections by use of prefabricated "L" and "T" sections.
   e. Cut and bend as required.
   f. Install reinforcing at 16 IN OC vertically unless noted otherwise on Drawings.
   g. Install reinforcing 8 IN OC in starter courses, over openings, and in parapet walls.
   h. Use continuous joint reinforcing for bond tie between wythes.
2. Reinforce masonry openings over 12 IN wide with horizontal joint reinforcing placed in two horizontal joints above lintel and below sill.
   a. Extend reinforcing minimum of 24 IN beyond jambs of opening.
   b. Bridge control joints where provided.
3. At intersecting load-bearing walls, provide rigid steel anchors 16 IN OC vertically, embed ends in grout filled cores.
4. Install vertical reinforcing bars where indicated on Drawings.

END OF SECTION

SECTION 04210

BRICK MASONRY

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SECTION 04210

BRICK MASONRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Work under this Section includes all brick work required to complete the masonry portion of this project.

1.3 SAMPLES AND SUBMITTALS

A. Samples: Submit four (4) sample boards of exposed masonry unit as required. Include the full range of exposed color and texture to be expected in the complete work. Architect's review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

B. Submittals: For information only, submit 2 copies of the manufacturer's specifications and other data for each type of masonry unit and accessory required including certification that each type complies with the specified requirement. Include instructions for handling, storage, installation and protection of each.

1.4 MANUFACTURER

A. Obtain masonry units from one manufacturer, of uniform texture and color for each kind required, for each continuous area and visually related areas.

1.5 STANDARDS

A. Comply with recommendations of ACI 530.1/ASCE 6/TMS 602, Specifications for Masonry Structures.

PART 2 – PRODUCTS

2.1 FACING BRICK

A. Brick shall comply with ASTM C216, Grade SW, Type FBS, 60% (min.) solid area, standard size. Provide up to four (4) brick color range samples for the two color ranges selected from a minimum of two manufacturers.

2.2 MORTAR MATERIALS

A. Portland Cement shall comply with ASTM C-150, Type I or II, except Type III may be used for cold weather protection. Provide natural color cement.

B. Hydrated Lime shall comply with ASTM C-207, Type S.

C. Sand shall comply with ASTM C-144.

D. Water shall be potable water.

2.3 FLASHING FOR MASONRY

A. Provide concealed flashings, shown to be built into masonry. Flashing, unless indicated otherwise, shall be as follows:

B. Virgin polyvinyl chloride with plasticizers and other modifiers, formed into uniform flexible sheets not less than 20 mils thick and black in color, unless otherwise indicated.

2.4 WEEPS

A. Unless otherwise indicated, provide 1/4" x 4" long sash cord weeps at maximum spacing of 24" on center.

2.5 MASONRY VENEER ANCHORS

A. General: Provide 2-piece assemblies allowing vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

B. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a galvanized wire tie section and a galvanized metal anchor section complying with the following requirements:
   1. Wire Tie Shape: Triangular
   2. Wire Tie Length: As required to extend within 1 inch of masonry face.
   3. Anchor Section: Sheet-metal dovetail anchor section with screw hole.

PART 3 – EXECUTION

3.1 INSPECTION

A. Contractor must examine the areas and conditions under which masonry is to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Architect.

3.2 INSTALLATION, GENERAL

A. Thickness: Build masonry construction to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

B. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to fit adjoining work neatly. Use full units without cutting wherever possible.

C. Frozen Materials and Work: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.

D. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents. Do not use calcium chloride in mortar or grout.

E. Pattern Bond: Lay exposed masonry in running bond with vertical joints in each course centered on units in courses above and below. Bond and interlock each course of each wythe at corners, unless otherwise shown.

F. Lay out walls in advance to facilitate accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible, at other locations. Lay-up walls plumb and true and with courses level, accurately spaced and coordinated with other work.

G. Stopping and Resuming Work: Rack back 1/2 masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry and remove loose masonry units and mortar prior to laying fresh masonry.

3.3 BUILT-IN WORK

A. As the work progresses, built-in items shall be incorporated into the work. Fill in solidly with masonry around built-in items.

3.4 MORTAR BEDDING AND JOINTING

A. Mortar Mixes shall be in accordance with ASTM C-270, "Proportion Specifications", Type S for exterior work. Measure and batch materials either by volume or weight, such that the required proportions for mortar can be accurately controlled and maintained. Measurement of sand exclusively by shovel will not be permitted.

B. Mix mortar ingredients for a minimum of 5 minutes in a mechanical batch mixer. Use water clear and free of deleterious materials which would impair the work. Do not use mortar which has begun to set, or if more than 2-1/2 hours has elapsed since initial mixing. Retemper mortar during 2-1/2 hour period as required to restore workability.

C. Lay brick with completely filled bed and head joint, butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

D. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8 inch joints. Cut joints flush for masonry walls which are to be concealed or to be covered by materials. Tool exposed joints slightly concave. Rake out mortar in preparation for application of caulking or sealants where shown.

E. Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

3.5 ANCHORING MASONRY WORK

A. Space veneer anchors not more than 24 inches on center vertically and horizontally. Provide additional anchors within one foot of openings and space not more than three feet around perimeter.

3.6 LINTELS

A. Provide minimum bearing at each jamb of 4 inches for openings less than 6 feet and 8 inches for wider openings.

3.7 FLASHING OF MASONRY WORK

A. Provide concealed flashings in masonry work as shown. Prepare masonry surfaces smooth and free from projections which might puncture flashing. Place through-wall flashings on bed of mortar and cover with mortar. Seal flashing penetrations with mastic before covering with mortar. Terminate flashings 1/2" from face of wall, unless otherwise shown. Extend flashings beyond edge of lintels and sills (if any) at least 4" and turn up edge on sides to form pan to direct moisture to exterior. Provide weep holes in the head joints of the first course of masonry immediately above concealed flashing, spaced 16" on center unless otherwise shown.

3.8 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent work to

provide a neat, uniform appearance properly prepared for application of caulking or sealant compounds.

3.9 WEEP HOLES

A. Provide weep holes as specified herein.

3.10 BRICK ALLOWANCE

A. Include the cost of $300.00 per thousand for face brick delivered to the site. After selection of the actual brick to be used, a Change Order will be issued to add to or deduct from the Contract amount any difference between the actual cost charged and the allowance.

END OF SECTION

SECTION 04220

CONCRETE MASONRY

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SECTION 04220

CONCRETE MASONRY

PART 1 – GENERAL

1.1 SUMMARY

A. *Section Includes:*
   1. Concrete masonry construction (CMU) and sills.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete.*
   4. Section 04110 - Cement and Lime Mortars.
   5. Section 04155 - Masonry Accessories.
   6. Section 04510 - *Masonry Cleaning.*
   7. Section 07900 - *Joint Sealants.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 530, Building Code Requirements for Masonry Structures.
      b. 530.1, Specification for Masonry Structures.
   2. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. C90, Standard Specification for Load bearing Concrete Masonry Units.
      c. C744, Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
   3. Underwriters Laboratories, Inc. (UL):
      a. Building Materials Directory.

B. Mock-Ups:
   1. Construct sample wall(s) minimum 4 FT high x 8 FT long utilizing all specified components for Engineer review and acceptance.
   2. Sample wall shall constitute minimum standard of quality for actual construction. Maintain sample wall during construction.
   3. If not acceptable, construct additional sample walls as required.
   4. Remove when directed by Engineer.
   5. Sample wall may be built into permanent wall provided sample area is readily identifiable during construction.
   6. Sample wall to include all special corners and other special CMU detailing, including prefaced masonry units.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. *Manufacturer's installation instructions.*
   3. Manufacturer's full line of colors for split face masonry for Engineer's color selection.
   4. Dimensional data on fluted, ribbed, and split face units.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.

B. Protect units from damage.

C. Provide plastic, tarps, or other suitable cover to protect masonry units from precipitation or ground water.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete Masonry Units:
   1. Modular lightweight units, ASTM C90, (Provide aggregate in accordance with ASTM C33.)
   2. Sizes and shapes as indicated on Drawings or required for conditions.
   3. Face shell and web thickness: ASTM C90, Table 1.
   4. Special shapes and faces:
      a. Bullnose corner units.
   5. Moisture content.
   6. Fire resistive.
   7. Concrete bricks of same material, texture, and quality.

B. Masonry Accessories: Refer to Section 04155 - *Masonry Accessories.*

C. Mortar and Grout: Refer to Section 04110 - *Cement and Lime Mortars.*

D. Sealants: Refer to Section 07900 - *Joint Sealants.*

E. General Purpose Grout: Refer to Section 04110 - *Cement and Lime Mortars.*

F. Reinforcing Bars: Refer to Section 03002 - *Concrete* and as indicated on Drawings.

PART 3 – EXECUTION

3.1 GENERAL

A. Except as specifically stated herein, all masonry work shall comply with ACI 530 and 530.1.

3.2 PREPARATION

A. Verify that anchors and flashings are correct.

B. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints. Properly locate openings, movement type joints, returns, and offsets.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
   1. Build walls to thickness indicated on Drawings.
   2. Build single-width walls to actual thickness of masonry units.
   3. Build in flashing, reinforcing, and related accessory items.
      a. See Section 04155 - *Masonry Accessories* for installation of accessory items.
   4. Perform all cutting with masonry saws using saw blades as recommended by masonry unit manufacturer.
   5. Drill holes with power drill using drill bits as recommended by masonry unit manufacturer.
   6. Holes made by chipping unit will not be accepted.
   7. Install masonry units in running bond.
   8. Split face masonry walls shall be strung on the smooth side of the wall.
   9. Cut as required to maintain bond pattern.
   10. Use solid units where cutting or laying would expose holes.
   11. Avoid use of less than half size units, whenever possible.
   12. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
   13. Do not wet concrete masonry units.
   14. Build chases and recesses as indicated and required for work of other trades. Provide not less than 8 IN of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

C. Concrete Masonry Units:
   1. Install grouted hollow units under lintel bearing points.
      a. Consolidate grout fill.

D. Laying and Tooling:
   1. Lay masonry units with completely filled bed and head joints.
      a. Butter ends with sufficient mortar to fill head joints and lay into place.
      b. Do not slush head joints.
   2. Maintain nominal 3/8 IN joint widths.
      a. Cut joints flush where concealed.
      b. Tool exposed joints concave.
      c. Compress mortar in below ground joints.
   3. During tooling of joints, enlarge any voids or holes, and completely fill with mortar.
   4. Point-up all joints at corners, openings, and adjacent work to provide neat, uniform appearance.
   5. Remove masonry disturbed after laying.
      a. Clean and relay in fresh mortar.
      b. Do not pound units to fit.
      c. If adjustments are required, remove units, clean, and reset in fresh mortar.
   6. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
      a. Remove loose units and mortar prior to laying fresh masonry.
   7. As work progresses, build in items indicated on Drawings and specified.
      a. Fill in solidly with mortar around built-in items.
      b. Where built-in items are to be embedded in cores of hollow masonry units, place layer of fiberglass mesh in joint below and fill core with general purpose grout.

E. Lintels, Control Joints and Sealants.
   1. Provide vertical expansion, control and isolation joints where indicated on Drawings.
      a. Where not indicated on Drawings, provide at maximum 24 FT OC or at natural point of weakness.
      b. Provide at all T-intersections.
      c. Rake out mortar in joint.
   2. Refer to Section 07900 - *Joint Sealants* for sealant installation requirements.
      a. Seal control and expansion joints.
   3. Provide unit masonry lintels where indicated on Drawings.
      a. Thoroughly cure lintels before handling and installation.
      b. See lintel schedule on Drawings for size and type required.

F. Tolerances:
   1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises:
      a. 1/4 IN in 10 FT.
      b. 3/8 IN in a story height not to exceed 20 FT.
      c. 1/2 IN in 40 FT or more.
   2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous lines:
      a. 1/4 IN in any story or 20 FT maximum.
      b. 1/2 IN in 40 FT or more.
   3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
      a. 1/4 IN in any bay or 20 FT.
      b. 1/2 IN in 40 FT or more.
   4. Maximum variation from plan location of related portions of columns, walls, and partitions:
      a. 1/2 IN in any bay or 20 FT.
      b. 3/4 IN in 40 FT or more.
   5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:
      a. Minus 1/4 IN.
      b. Plus 1/2 IN.

G. Protect against weather when work is not in progress. During inclement weather conditions, cover top of walls with waterproof membrane, extend at least 4 FT down both sides of walls and anchor in place.

H. Protect against weather when work is not in progress. During inclement weather conditions, cover top of walls with waterproof membrane, extend at least 4 FT down both sides of walls and anchor in place.

3.4 FIELD QUALITY CONTROL

A. Remove and replace loose, stained, or damaged units as directed by Engineer.
   1. Provide new units to match.
   2. Install in fresh mortar.
   3. Point to eliminate evidence of replacement.

3.5 CLEANING

A. Clean masonry in accordance with Section 04510 - *Masonry Cleaning*.

END OF SECTION

SECTION 04510

MASONRY CLEANING

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SECTION 04510

MASONRY CLEANING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Masonry cleaning.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Use experienced workmen familiar with product and its application.

1.3 SUBMITTALS

A. Letter stating that Contractor is experienced in this type of masonry cleaning.

B. Letter from cleaning solutions manufacturer stating that product being used is compatible with and is intended for use on prefaced masonry units.

C. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Manufacturer's application instructions.
      b. Manufacturer's recommendations on neutralizing rinse.
      c. Manufacturer's mixing recommendations.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Cleaning solution: Detergent type.
      a. PROSOCO.
      b. APChem, Inc.
      c. Or approved equal.
   2. Cleaning solution for manganese or vanadium stained masonry:
      a. PROSOCO.
      b. APChem, Inc.
      c. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitutions.*

2.2 MATERIALS

A. Detergent-Type Cleaning Solution:
   1. PROSOCO "Sure Klean 600 Detergent".
   2. APChem "BC-10".
   3. Or approved equal.

B. Manganese or Vanadium-Stained Masonry:
   1. PROSOCO "Sure Klean Vana Trol".
   2. APChem "VAN-O-CRETE".
   3. Or approved equal.

C. Water: Potable.

D. Neutralizing rinse as required by manufacturer.

PART 3 – EXECUTION

3.1 PREPARATION

A. Allow 4 days after completion of masonry work before start of cleaning.

B. Remove excess mortar using wooden paddles and scrapers.

C. Protect adjacent surfaces not to be cleaned.

3.2 APPLICATION

A. Mix material in strict accordance with manufacturer's recommendations.

B. Apply masonry cleaner to exposed-to-view masonry surfaces.
   1. Do not use wire brushes.
   2. Use only tools free of rust.
   3. Apply solution using fibered wall-washing brush.

C. Thoroughly rinse and pre-soak walls.

D. Flush all loose mortar and dirt from surface.

E. Wet to prevent "run-off" streaking.

F. Scrape off mortar and reapply cleaning solution.

G. After scrubbing, clean thoroughly with pressurized water.

H. Apply neutralizing rinse as recommended by manufacturer.

END OF SECTION

SECTION 04860

STONE VENEER ASSEMBLIES

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SECTION 04860

STONE VENEER ASSEMBLIES

PART 1 – GENERAL

1.1 SUMMARY

1. This Section includes stone veneer in the following applications:
   a. Anchored to concrete backup.
   b. Anchored to unit masonry backup.

1.2 SUBMITTALS

1. Product Data: For each type of product indicated.
   a. For stone varieties proposed for use on Project, include data on physical properties required by referenced ASTM standards.
2. Stone Samples: For each color, grade, finish, and variety of stone required.
3. Colored Mortar Samples: For each color required.
4. Qualification Data: For Installer.

1.3 QUALITY ASSURANCE

1. Installer Qualifications: An installer who employs experienced stone masons and stone fitters who are skilled in installing stone veneer assemblies similar in material, design, and extent to those indicated for this Project and whose projects have a record of successful in-service performance.
2. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
   a. Build mockups for each type of stone veneer assembly in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup.

1.4 PROJECT CONDITIONS

1. Protection of Stone Veneer Assemblies: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work.
2. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone veneer assemblies.
3. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   a. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried.
4. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

1. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2.2 STONE

1. Quartz-Based Dimension Stone Standard: ASTM C 616, Classification I Sandstone.

2.3 MORTAR MATERIALS

1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   a. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
2. Hydrated Lime: ASTM C 207, Type S.
3. Masonry Cement: ASTM C 91.
4. Aggregate: ASTM C 144 and as follows:
   a. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
   b. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
5. Water: Potable.

2.4 VENEER ANCHORS

1. Materials:
   a. Hot-Dip Galvanized Steel Wire: ASTM A 82, with ASTM A 153/A 153M, Class B-2.
   b. Hot-Dip Galvanized Steel Sheet: ASTM A 366/A 366M, cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M, Class B-2.
2. Adjustable Veneer Anchors: 2-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to wall, for attachment over sheathing to wood or metal studs, and that are capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   a. Screw-Attached Veneer Anchors: Units with triangular wire tie and rib-stiffened, sheet metal anchor section with screw holes top and bottom and with raised rib-stiffened strap stamped into center to provide a slot for connection of wire tie.
      1) Available Products:
         a) Dur-O-Wal, a Dayton Superior Company; D/A 210 with D/A 700-708.
         b) Heckmann Building Products, Inc.; 315-D with 316.
         c) Hohmann & Barnard, Inc.; DW-10HS.
         d) Masonry Reinforcing Corporation of America; 1004, Type III.
   b. Seismic Veneer Anchors: Units with rib-stiffened, sheet metal anchor section with screw holes top and bottom and with raised rib-stiffened strap stamped into center to provide a slot for a connector section designed to engage continuous wire embedded in the veneer mortar joint.

1) Available Products:
   a) Dur-O-Wal, a Dayton Superior Company; D/A 213S.
   b) Hohmann & Barnard, Inc.; DW-10-X-Seismiclip.
   c) Masonry Reinforcing Corporation of America; RJ-711 with Wire-Bond Clip.

2.5 EMBEDDED FLASHING MATERIALS

1. Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:

   a. Material: Stainless steel, 0.0156 inch thick.

2. Contractor's Option for Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use the following, unless otherwise indicated:

   a. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable and highly adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of 0.030 inch.
      1) Available Products:
         a) Dur-O-Wal, a Dayton Superior Company; Dur-O-Barrier.
         b) Grace, W. R. & Co., Construction Products Division; Perm-A-Barrier Wall Flashing.
         c) Hohmann & Barnard, Inc.; Textroflash.
         d) Polyguard Products, Inc.; Polyguard 300.
         e) Polytite Manufacturing Corp.; Poly-Barrier Self-Adhering Wall Flashing.
         f) Williams Products, Inc.; Everlastic MF-40.

2.6 MASONRY CLEANERS

1. Job-Mixed Detergent Solution: Solution of 1/2-cup dry-measure tetrasodium polyphosphate and 1/2-cup dry-measure laundry detergent dissolved in 1 gal. of water.

2.7 STONE FABRICATION

1. General: Fabricate stone in sizes and shapes necessary to comply with requirements indicated, including details on Drawings.

2. Gage backs of stones for adhered veneer if more than 81 sq. in. in area.

3. Shape stone for type of masonry (pattern) as follows:
   a. Split-bed, random-range ashlar with random course heights and random lengths (interrupted coursed).
4. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.
   a. Finish: Split face.
   b. Finish for Sills: Split face with sand-rubbed finish on washes.

2.8 MORTAR MIXES

1. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   a. Do not use calcium chloride.
   b. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

2. Mortar for Stone Masonry: Comply with ASTM C 270, Proportion Specification.
   a. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
   b. Mortar for Setting Stone: Type S or N.
   c. Mortar for Pointing Stone: Type N or O.

3. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

4. Cement-Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.
   a. For latex-modified portland cement setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.

PART 3 — PART 3 - EXECUTION

3.1 SETTING OF STONE VENEER, GENERAL

1. Accurately mark stud centerlines on face of building paper or building wrap before beginning stone installation.
2. Perform necessary field cutting as stone is set. Use power saws to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
3. Arrange and trim stones for accurate fit in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.
4. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment, if any. Lay walls with joints not less than 3/8 inch at narrowest points nor more than 5/8 inch at widest points.
5. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
   a. At cold-formed metal-framed walls, extend flashing from exterior face of veneer, through the veneer, up the face of sheathing at least 8 inches, and behind building paper or building wrap.
   b. At lintels and shelf angles, extend flashing full length of angles but not less than 4 inches into masonry at each end.
   c. At heads and sills, extend flashing 4 inches at ends and turn up not less than 2 inches to form a pan.
   d. Extend sheet metal flashing 1/2 inch beyond face of masonry at exterior and turn flashing down to form a drip.
   e. Subparagraph above can be accomplished only with sheet metal flashing. Retain one of three subparagraphs below if flexible flashing materials are used. See the Evaluations in Division 4 Section "Unit Masonry Assemblies."
   f. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.
   g. Install metal flashing termination beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal flashing termination.
   h. Cut flashing flush with face of wall after masonry wall construction is completed.
6. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.
   a. Use wicking material to form weep holes.
   b. Use wicking material to form weep holes above flashing in stone sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
   c. Retain subparagraph below if plastic tubing or wicking material is retained for weep holes in Part 2.
   d. Space weep holes formed from wicking material 16 inches o.c.
7. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

8. Install vents in vertical head joints at the top of each continuous cavity at spacing indicated. Use round plastic tubing or open head joints to form vents.

3.2 CONSTRUCTION TOLERANCES

1. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
2. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
3. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.

3.3 INSTALLATION OF ANCHORED STONE VENEER ASSEMBLIES

1. Anchor stone veneer to concrete with corrugated-metal veneer anchors as follows:
   a. Secure veneer anchors by inserting dovetailed ends into dovetail slots in concrete.
   b. Embed veneer anchors in mortar joints to within 1 inch of face.
2. Anchor stone veneer to unit masonry with metal veneer anchors as follows:
   a. Embed corrugated-metal anchors in unit masonry mortar joints or grouted cells for distance at least one-half of veneer thickness.
   b. Secure wire anchors by inserting pintles into eyes of masonry wall reinforcement projecting from horizontal mortar joints.
   c. Secure triangular wire anchors with vertical rods inserted through anchors and through eyes of masonry wall reinforcement projecting from horizontal mortar joints.
   d. Embed anchors in veneer mortar joints to within 1 inch of face.
3. Anchor stone veneer to cold-formed metal framing with adjustable, screw-attached veneer anchors as follows:
   a. Fasten each anchor section through sheathing to framing with two screws.
   b. Embed wire tie section in mortar joints to within 1-1/2 inches of face.
4. Space veneer anchors not more than 18 inches (450 mm) o.c. vertically and 32 inches (800 mm) o.c. horizontally, with not less than 1 veneer anchor per 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional veneer anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding 12 inches (300 mm).
5. Set stone in full bed of mortar with full head joints, unless otherwise indicated. Build veneer anchors into mortar joints as stone is set.
   a. Install continuous wire reinforcement in horizontal joints indicated and attach to seismic veneer anchors as stone is set.
6. Fill space between back of veneer and building paper or building wrap with mortar as stone is set.
7. Rake out joints for pointing with mortar to depth of not less than 1/2 inch. Rake joints to uniform depths with square bottoms and clean sides.

3.4 POINTING

1. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.
2. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch deep. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
3. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
   a. Joint Profile: Concave.

3.5 ADJUSTING AND CLEANING

1. In-Progress Cleaning: Clean stone veneer assemblies as work progresses. Remove mortar fins and smears before tooling joints.

2. Final Cleaning: After mortar is thoroughly set and cured, clean stone veneer assemblies as follows:
   a. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   b. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes.
   c. Protect adjacent stone and nonmasonry surfaces from contact with cleaner.
   d. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
   e. Clean stone veneer assemblies by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.

3.6 EXCESS MATERIALS AND WASTE

1. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
   a. Do not dispose of masonry waste as fill within 18 inches of finished grade.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

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SECTION 05120

STRUCTURAL STEEL

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete.*
   4. Section 05505 - *Metal Fabrications.*
   5. Section 09905 - *Painting and Protective Coatings.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC):
      a. Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
      b. Code of Standard Practice for Steel Buildings and Bridges (referred to herein as AISC Code of Standard Practice). Section 4, Paragraph 4.2.1 is specifically excluded from these Specifications.
      c. Quality Certification Program.
      d. Manual of Steel Construction.
   2. American National Standards Institute (ANSI):
      a. B18.22.1, Plain Washers.
   3. American Society for Testing Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A53, Welded and Seamless Steel Pipe.
      c. A307, Carbon Steel Externally Threaded Standard Fasteners.
      d. A325, High-Strength Bolts for Structural Steel Joints.
      e. A500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      f. A501, Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
      g. A572, Grade 50 - Structural Steel.
      h. A582, Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished.
      i. A992, Standard Specification for Structural Steel Shapes.
   4. Specification for Structural Joints using ASTM A325 or A490 Bolts as approved by the Research Council on Riveted and Bolted Structural Joints (referred to herein as Specification for Structural Joints).
   5. American Welding Society (AWS):
      a. A5.1, Specification for Mild Steel Covered Arc Welding Electrodes.
      b. A5.5, Specification for Low-Alloy Steel Covered Arc Welding Electrodes.
      c. A5.17, Specification for Bare Mild Steel Electrodes and Fluxes for Submerged-Arc Welding.
      d. A5.18, Specification for Mild Steel Electrodes for Gas Metal-Arc Welding.
      e. A5.20, Specification for Mild Steel Electrodes for Flux-Cored Arc Welding.
      f. A5.23, Specification for Bare Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding.
      g. D1.1, Structural Welding Code (referred herein as AWS Code.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Fabrication and/or layout drawings:
      a. Steel erection plans and details including connection details:
         1) Show all cuts, copes, holes and welds.
         2) Indicate all shop and field welds using AWS symbols.
         3) Reviewed and sealed by professional engineer retained by Contractor to verify conformance with design criteria stipulated in the Contract Documents.
      b. Prepare structural steel shop drawings under National Institute of Steel Detailing Quality Procedures Program certification.
      c. Coordinate with Engineer before starting work on the shop drawings to discuss the design criteria stipulated in the Contract Documents.
      d. Complete shop drawings for all of the work showing clearly all pieces, details, connections and paint. Contractor not permitted to reproduce Engineer's framing plans for this purpose. Prepare independent complete erection drawings showing the marks of all pieces.
      e. All shop drawings checked and signed approved by the checker before submittal.
      f. Copies of up-to-date erection drawings, containing marks of all pieces submitted for review shall accompany the shop drawings. Use match marks on the structural steel erection drawings to indicate the sheet number on which each particular member is detailed.
      g. Correct any incorrect or unacceptable material or fabrication due to incorrect detailing, shop work, or erection, without additional charge.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Detailed supplemental specification relating to load indicator washers or high-strength bolts - alternate design for approval of Engineer (submitted at Contractor's option if desired by Contractor for use).
   4. Certifications:
      a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
      b. Copies of welding certificates for each person assigned to perform field welding indicating compliance with testing specified by AWS.
   5. Test reports:
      a. Certified copies of mill tests.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Division, TRW, Inc.
      b. KSM Division Omark Industries.
      c. Or approved equal.
   2. Stainless steel concrete anchors:
      a. See *Section 05505 -Metal Fabrications.*
   3. High-strength bolts:
      a. Bethlehem Steel Corporation.
      b. Lewis Bold & Nut Company.
      c. Nucor Fasteners.
      d. St. Louis Screw and Bolt Company.

e. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution*.

2.2 MATERIALS

A. Steel, Structural Shapes and Plate:
1. W, WT: ASTM A992, Fy = 50 ksi.
2. HSS - Square & Rectangular: ASTM A500, Grade B, Fy = 46 ksi
3. HSS - Round: ASTM A500 or A501, Grade B, Fy = 42 ksi
4. Steel Pipe: ASTM A53, Grade B, Fy = 35 ksi
5. Other shapes & Plate: ASTM A36, Fy = 36 ksi

B. High-Strength Bolts, Nuts and Washers:
1. High-strength bolts: ASTM A325
   a. Provide nuts meeting the requirements of ASTM A563 with all high strength bolts.
   b. Provide washers meeting the requirements of ASTM F436 with all nuts.

C. Bolts, Unfinished: ASTM A307, Grade A.

D. Washers, Plain (Unfinished Bolts): ANSI B18.22.1, Type B.

E. Welding Electrodes:
1. Shielded metal-arc: AWS A5.1 or AWS A5.5, E70XX.
2. Submerged-arc: AWS A5.17 or A5.23, F7X-EXXX.
3. Gas metal-arc: AWS A5.18, E70S-X or E70U-1.
4. Flux cored-arc: AWS A5.20, E70T-X (except 2, 3, 10, GS).

F. Anchor Bolts: ASTM A36 for non-headed bolts; ASTM A307, Grade A for headed bolts.

G. Nonshrink Grout: See Section 03002 - *Concrete*.

H. Stainless Steel Expansion Bolts: See Section 05505 - *Metal Fabrications*.

2.3 FABRICATION

A. Comply with requirements of applicable building codes and AISC Specification with modifications and additional requirements specified herein.

B. Minimize the amount of field welding. Shop assemble components into largest size possible commensurate with transportation and handling limitations.
1. Shop connections: Bolted with high-strength bolts or welded.

C. Connection Details:
1. Connections not fully detailed on Drawings shall be designed by a Professional Engineer registered in the State of Virginia, retained by Contractor, based on requirements of Contract Documents.
2. Where beam reactions are shown on Drawings, design beam connection to support reaction shown.
3. Where no reactions are shown each beam connection shall be designed to support one-half of total uniform load capacity tabulated in AISC tables for "Uniform Load Constants for Beams" for the given shape, span and steel specified.
4. Where indicated on the Drawings, design beam connections for the axial load or transfer forces indicated in addition to the shear value indicated above.

D. Provide as a minimum, 3/4 IN DIA, ASTM A325 high-strength bolts for all bolted connections.

E. Minimum of two bolts per bolted connection.

F. Provide bearing-type connections for all bolted connections.

G. One-sided or other types of eccentric connections not indicated will not be permitted without prior approval.

H. Accurately mill bearing surfaces to true plane.

I. Fabricate and erect beams without specified camber in accordance with AISC Specification Chapter L1.

J. Cut, drill, or punch holes at right angles to surface of metal.
   1. Do not make or enlarge holes by burning.
   2. Make holes clean cut, without torn or ragged edges.
   3. Remove outside burrs resulting from drilling or reaming operations with tool making 1/16 IN bevel.
   4. Provide holes in members to permit connection of work of other trades or contractors.

K. Make allowance for draw in all cross bracing to provide small amount of initial tension in members.

L. Make splices only where indicated or where approved.

M. Field Connections: Provide bolts for all field connections except where shown otherwise on the Drawings.
   1. Use high-strength bolts (any one of three types of ASTM A325 bolts), unless shown or specified otherwise.
   2. Use of high-strength bolts: Conform to "Specifications for Structural Joints Using ASTM A325 or A490 Bolts," as approved by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation, and published by AISC.
   3. Unfinished bolts may be used for attaching stair treads to stringers.
   4. If structural steel details (field welds versus shop welds, etc.) shown on design Drawings are not compatible with erection procedures, submit proposed modifications for review.
   5. Prior to making field connections to existing structural steel, remove completely all paint from existing steel which will be in contact with new steel and new welds.
   6. Connections to structural steel provided by others: Provide all connectors and coordinate location of bolt holes to match connection holes in steel provided by others.

N. Wall Girts: Extend past columns and miter ends unless noted otherwise. Connect girts at corners unless noted otherwise.

O. Headed Studs and Deformed Bar Anchors:
   1. Automatically end welded in accordance with the AWS Code and manufacturer's recommendations.
   2. Fillet welding of headed studs and deformed bar anchors is not allowed.

P. Cope at 45 degrees, corners of stiffener plates at junction of member flanges with webs.

Q. Flame cut bevels for field welds, provided such cutting is done automatically. Leave free of burrs and slag.

R. Grind smooth all rough welds and sharp steel edges shall be ground to approximately 1/8 IN radius.

2.4 SHOP WELDING

A. Comply with AWS Code, and other requirements indicated herein, for all welding, techniques of welding employed, appearance and quality of welds, and methods used to correct defective work.

B. Test and qualify welders, welding operators and tackers in compliance with AWS Code for position and type of welding to which they will be assigned.

C. Before Starting Welding:
   1. Carefully plumb and align members in compliance with specified requirements.
   2. Preheat base metal to temperature stated in Table 4.2 of AWS Code.
      a. When no preheat temperature is given in Table 4.2 and base metal is below 50°F, preheat base metal to at least 70°F.
      b. Maintain temperature during welding.
      c. Preheat surface of all base metal within distance from point of welding equal to thickness of thicker part being welded or 3 IN, whichever is greater, to specified preheat temperature.
      d. Maintain this temperature during welding.
   3. Fully tighten bolts.
   4. Comply with Section 3 of AWS Code for assembly and surface preparation.
   5. Each welder shall use identifying mark at welds where he has worked.

D. Where groove welds have back-up plates, make first three passes with 1/8 IN round electrodes.

E. Use backup plates in accordance with AWS Code, extending minimum of 1 IN either side of joint.

F. Make flange welds before making web welds.

G. Grind flush web fillets at webs notched to receive backup plates for flange groove welds.

H. Manual Shielded Metal-Arc Welding: Comply with Article 4.6 of AWS Code.

I. Low Hydrogen Electrodes: Dry and store electrodes in compliance with AWS Code.

J. Do not perform welding when ambient temperature is lower than 0°F or where surfaces are wet or exposed to rain, snow, or high wind, or when welders are exposed to inclement conditions.

K. When headed stud-type shear connectors are to be field applied, clean top surface of members to receive studs in shop to remove oil, scale, rust, dirt, and other materials injurious to satisfactory welding. Do not shop paint or galvanize metal surfaces to receive field applied studs.

L. Test in-place studs in accordance with requirements of AWS Code qualification procedures to ensure adequate welding of studs to members.

2.5 SHOP COATING

A. Refer to Section 09905 - *Painting and Protective Coatings* and coordinate shop primer and coating with field applied primers and coatings where specified.

B. Provide suitable methods of handling and transporting painted steel to avoid damage to coating.

C. Do not coat following surfaces:
   1. Machined surfaces, surfaces adjacent to field welds, and surfaces fully embedded in concrete or covered with fireproofing.
   2. All other members for which no coating is specified.
   3. Contact surfaces at bolted friction connections.

D. Clean thoroughly all surfaces not coated before shipping. Remove loose mill scale, rust, dirt, oil, and grease. Protect machined surfaces.

E. Testing: Owner will employ and pay for services of an independent testing agency to inspect and test structural steel work for compliance with Specifications. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control

to ensure compliance with Contract Documents. Contractor provides sufficient notification and access so inspection and testing can be accomplished. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

PART 3 – EXECUTION

3.1 GENERAL

A. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing are installed.

B. Plumb, align, and set structural steel members to specified tolerances. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary. Use temporary guys, bracing, shoring, and other work to prevent damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind. Remove and dispose of all temporary work and facilities off site.

C. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work. Report defects in work-in-place which may influence satisfactory completion of the work. Absence of such notification will be construed as acceptance of work-in-place.

D. Field Measurement: Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings. Contractor responsible for the accurate fit of the work.

E. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection. Use surveyor's level. Notify Engineer of any errors or deviations found by such checking.

3.2 ERECTION

A. Conform to provisions of AISC "Code of Standard Practice for Steel Buildings," Section 7 "Erection," except where shown or specified otherwise in Contract Documents. Provisions in Contract Document shall hold priority to provisions of "Code of Standard Practice for Steel Buildings," where conflicts exist.

B. Framing member location tolerances after erection shall not exceed the frame tolerances listed in Article 3.3.

C. Erect plumb and level; introduce temporary bracing required to support erection loads.

D. Use light drifting necessary to draw holes together. Drifting to match unfair holes is not allowed.

E. Welding: Conform to AWS D1.1 "Structural Welding Code" and requirements of Article 2.4. When joining two sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.

F. Shore existing members when unbolting of common connections is required. Use new bolts for rebolting connections.

G. Clean stored material of all foreign matter accumulated during erection period.

H. Install ASTM A325 bolts with hardened washers. Install and tighten in accordance with Section 8 of Specifications for Structural Joints.

1. Coordinate installation with inspection. Do not start installation until coordination with Testing Agency is complete.
2. Bearing-type connections: High-strength bolts shall be tightened to snug-tight condition.
3. In the event any bolt in a connection is found to be defective, check and retighten all bolts in the connection.

I. Do not use gas cutting to correct fabrication errors. In case members do not fit or holes do not match, ream out the holes and insert the next larger size bolt. If the connections require new holes, then drill new holes. Make no such corrections without prior approval of the Engineer.
   1. Burning of holes: Not permitted.

J. Tighten and leave in place erection bolts used in welded construction.

K. Provide beveled washers to give full bearing to bolt head or nut where bolts are to be used on surfaces having slopes greater than 1 in 20 with a plane normal to bolt axis.

L. After bolts are tightened, upset threads of A307 unfinished bolts to prevent nuts from backing off.

M. After erection, grind smooth all sharp surface irregularities resulting from field cutting or welding; power tool clean welds, bolts, washers and abrasions to shop coat removing all rust and foreign matter.

N. Wedge-type expansion bolts to have a minimum embedment of 4 IN into concrete or masonry unless noted otherwise on Drawings.

3.3 FIELD QUALITY CONTROL

A. Tolerances (unless otherwise noted on the Contract Drawings):
   1. Frame placement, after assembly and before welding or tightening:
      a. Deviation from plumb, level and alignment: 1 in 500, maximum.
      b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.
      c. Displacement of centerlines of exterior columns: 1/2 IN maximum, each side of centerline location shown on Drawings.

3.4 CLEANING AND REPAIR OF SHOP PRIMER PAINT

A. After erection, clean all steel of mud or other foreign materials, and repair any damage. Comply with Section 09905 - *Painting and Protective Coatings*.

END OF SECTION

SECTION 05131

STRUCTURAL ALUMINUM

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SECTION 05131

STRUCTURAL ALUMINUM

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural aluminum.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. SAS-30, Specifications for Aluminum Structures.
      b. ASD1, Aluminum Standards and Data.
      c. ED-33, Engineering Data for Aluminum Structures.
   2. American Institute of Steel Construction (AISC):
      a. Manual of Steel Construction.
   3. American National Standards Institute (ANSI):
      a. B18.2, Square and Hexagon Bolts and Nuts.
      b. B18.22.1, Plain Washers.
   4. American Society for Testing and Materials (ASTM):
      a. B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
      b. B247, Specification for Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
      c. B308, Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
      d. F467, Specification for Nonferrous Nuts for General Use.
      e. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
      f. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   5. American Welding Society (AWS):
      a. D1.2, Structural Welding Code-Aluminum.

B. Qualifications:
   1. For welding aluminum: Qualify welding procedures and welding operators in accordance with AWS D1.2. Welding operators to have been qualified during the 12-month period prior to commencement of welding.
   2. Connections and members not detailed on the Drawings shall be designed by a registered professional Structural Engineer in the state where the Project is located.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.
   2. Fabrication and/or layout drawings:
      a. Submit shop drawings for all items. Do not deliver any material before approved shop drawings have been returned. Show all shop and erection details including cuts, copes, connections, holes, bolts, welds, and anchorage details. Use AWS standard welding symbols and show size, length, and type of each weld. Shop drawings shall not be reproductions of the Contract Drawings.

b. Submit structural calculations and details of fabricator's design of members and connections not indicated on the Drawings. Do not start fabrication until approved shop drawings have been returned.

3. Product technical data including:
   a. Acknowledgment that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
4. Certifications.
5. Test reports.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Stainless steel wedge-type expansion bolts.
      a. Kwik Bolts by Hilti, Inc.
      b. Red Head by Phillips Drill Co.
      c. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Aluminum Shapes and Plates: Alloy 6061-T6.
   1. Provide aluminum members having dimensions and properties in accordance with AA Manual "Engineering Data for Aluminum Structures."
   2. Member dimensional tolerances: Comply with AA Manual "Aluminum Standards and Data."

B. Aluminum Bolts and Nuts: ASTM F467 and F468 of alloy 2024-T4.

C. Expansion Bolts for Fastening Aluminum to Concrete: Stainless steel wedge-type expansion bolts with stainless steel nuts and washers, Type 303 stainless steel.

D. Bolts and Nuts for Fastening Aluminum to Structural Steel: Stainless steel complying with ASTM F593, Type 303 or 304 with a minimum tensile strength of 70,000 psi and a minimum yield strength of 30,000 psi.

E. Washers: Same material and alloy as found in bolts and nuts with which the washers are to be used.

F. Electrodes for Welding Aluminum: Filler alloy 4043.

2.3 DESIGN CRITERIA

A. Where final design of members and connections for any portion of structure is not indicated, perform final design of such members and connections.

B. Final designs of members and connections shall conform to AA "Specifications for Aluminum Structures" and to details and requirements shown on Drawings.
   1. Design loads for members and connections shall be as shown on the Drawings.

2.4 FABRICATION

A. Fabrication of bolted and welded connections of aluminum work shall be in accordance with AA "Specifications for Aluminum Structures."

B. Contractor to be solely responsible for correctness of all shop and field fabrication and fit.

C. Fabricate aluminum work and assemble in shop to greatest extent possible.

D. Provide connections as indicated. Where not indicated, design and provide connections in accordance with requirements of this Section. One-sided or other types of eccentric connections are not acceptable unless indicated on Contract Drawings or approved on shop drawings.

E. Drill or punch holes at right angles to surface of metal. Do not make or enlarge holes by burning. Provide holes clean and free of torn or ragged edges. Use tools which will make a 1/16 IN bevel to remove outside burrs resulting from drilling or punching operations.

F. Cope at 45 degrees corners of stiffener plates at junction of member flanges with webs.

PART 3 — EXECUTION

3.1 ERECTION

A. Bolting: Connect aluminum members to aluminum members using 3/4 IN DIA aluminum bolts of alloy 2024-T4. Connect aluminum members to structural steel using 3/4 IN DIA stainless steel bolts. Connect aluminum members to concrete or masonry using 3/4 IN DIA stainless steel wedge-type expansion bolts. Where aluminum members are connected to masonry supports, place connection expansion bolts into masonry cells filled with concrete or masonry grout. Stainless steel wedge-type expansion bolts shall have a minimum embedment of 4 IN into masonry or concrete unless indicated otherwise on Drawings.

1. Protect bolt threads from damage during driving. Rest bolt heads and nuts squarely against surfaces. Where bolt heads or nuts rest on beveled surfaces having slope greater that 1 in 20 with plane normal to bolt axis, provide beveled washers to give full bearing to head and nut. Correct poor matching of holes by drilling to next larger size and use larger diameter bolt.

B. Welding: Weld connections to members in shop and bolt connections in field. Perform welding using electrodes of filler alloy 4043. Perform welding in accordance with AWS D1.2. Use only welding procedures and welding operators qualified in accordance with requirements of paragraph 1.02-B "Qualifications." Field welding of aluminum is not allowed unless indicated on Contract Drawings.

C. Correct fabrication errors and damaged members in shop. Do not use cutting torch in shop or in field to cut any members, to correct fabrication errors, or to cut openings.

D. Provide templates for anchors, bolts, and other items to be installed in other work.

E. Field Assembly: Tolerances shall comply with AISC "Manual of Steel Construction" Ninth Edition. Before members are assembled, thoroughly clean all bearing surfaces and surfaces that will be in permanent contact. After assembly, carefully align all members of each frame or assembly and accurately adjust until final, correct and true location is achieved. As work progresses, securely fasten in place.

1. Provide full length members without splices.
2. Securely tighten and leave in place all erection bolts used in welded construction, unless removal is required.

F. Setting Beam and Column Baseplates:

1. Concrete grout: Set beam and column base plates on nonshrink grout. See {Section 03308 - *Concrete, Materials, and Proportioning}* {Section 03002 - *Concrete*} for nonshrink grout requirements.
2. Construct top of bearing surface to an elevation that is lower than elevation of bottom of base plate by dimension indicated. If not indicated, provide minimum of 1 IN grout thickness under base plates.
3. Set and anchor each base plate to proper line and elevation. Use aluminum wedges, shims, or setting nuts for leveling and plumbing columns and beams. Fill space between

bearing surface and bottom of base plate with nonshrink grout. Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout. Do not remove wedges of shims and where they protrude, cut off flush with edge of base plate.

G. Temporary Protection: Suitably protect aluminum surfaces against lime mortar stains, discoloration, surface abrasion and other construction abuses. Remove protection during Predemonstration Period.

H. Contact with Dissimilar Materials: Where aluminum surfaces will be embedded in concrete, built into masonry, or in contact with steel, concrete, masonry, or other dissimilar materials, coat the aluminum surfaces as described in Section 09905 - *Painting and Protective Coatings*.

END OF SECTION

SECTION 05313

METAL DECK

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SECTION 05313

METAL DECK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal roof deck.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - *Painting and Protective Coatings.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Specification for the Design of Cold-Formed Steel Structural Members.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A611, Steel Sheet, Carbon, Cold Rolled, Structural Quality.
      c. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      d. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
      e. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
      f. D1056, Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
   3. American Welding Society (AWS):
      a. D1.3, Structural Welding Code - Sheet Steel.
   4. Steel Deck Institute (SDI):
      a. Design Manual for Composite Decks, Form Decks, and Roof Decks.
   5. Underwriter's Laboratories, Inc. (UL).

B. Qualifications:
   1. Manufacturer: Member of Steel Deck Institute.
   2. Qualification of welding work:
      a. Qualify welding processes, operations, and operators in accordance with requirements of Structural Welding Code - Sheet Steel, AWS D1.3.
      b. Welding operators to have been qualified during the 12-month period prior to commencement of welding, and be experienced in welding light gage metal.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Fabrication and/or layout drawings:
      a. Detailed shop drawings showing the following:
         1) Complete framing and erection layouts.
         2) Location, length and markings of metal deck units which correspond with sequence and procedure to be followed for erecting, fastening, and securing the deck units.
         3) Details and gages of accessories and miscellaneous items showing sump pans, cant strips, ridge and valley plates, closure strips and insulation supports.

4) Welding procedures for installation including size, number, type and location of all welds required to install deck units.
5) Correct fitting of members and accessories.
6) Size and location of all openings in deck and all conditions requiring closure panels.
7) Shop drawings shall not be reproductions of the Contract Drawings.

3. Product technical data including:
   a. Acknowledgment that products submitted meet requirements of standards referenced.
   b. Metal deck manufacturer's specifications and installation instructions.
   c. Manufacturer's specifications and installation instructions for:
      1) Galvanizing repair paint.
      2) Screws.
      3) Joint sealing compound.
   d. Manufacturer's load tables for deck to be furnished on this project, including allowable gravity load for deck and composite slab and allowable diaphragm shear values for deck.
4. Certifications:
   a. Manufacturer member of SDI.
   b. Welders.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from rusting, denting or crushing.
   1. Store metal deck on project site off the ground with one end elevated to provide drainage and protected from the elements with a waterproof covering, ventilated to avoid condensation. Prevent deterioration and accumulation of foreign material.

1.5 PROJECT CONDITIONS

A. Do not overload supporting members. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting code or stated design loads.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Vulcraft.
   2. United Steel Deck, Inc.
   3. Wheeling Corrugating Co.
   4. Epic Metals Corp.
   5. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution*.

2.2 STEEL DECK

A. The allowable superimposed live uniform loading per square foot for the deck supplied for the spans indicated shall equal or exceed the allowable superimposed live uniform load per square foot for the same spans as indicated in the Steel Deck Institute latest tables.

B. Minimum Deck Thickness:

1. Where gage of metal is indicated, provide the following:

Minimum Uncoated Decimal Thickness:	
Gage	Design Thickness
22	0.0295 IN
20	0.0358 IN
18	0.0474 IN
16	0.0598 IN
Note: The delivered thickness of the uncoated steel shall not be less than 95 percent of the design thickness.	

2. The steel used shall have a minimum yield stress of 33 ksi.

C. Maximum Deflection: Less than 1/240 of span under live load.

D. Minimum size and gauge as called on plans.

E. Fabrication:

1. Form deck units in lengths to span three or more support spacings with flush, telescoped or nested 2 IN end laps.
   a. Joints occur on supporting members.
   b. Provide deck units having interlocking male and female type side laps or joints to provide positive vertical and lateral alignment of adjacent deck units.
2. Use deck configurations complying with SDI "Basic Design Specifications" and as indicated.
3. Metal closure strips:
   a. Form to configuration required to provide tight-fitting closures at open ends and sides of decking.
   b. Minimum thickness before galvanizing 0.0358 IN (20 GA).
4. Cant strips:
   a. Bend cant strips to form 45°F slope not less than 5 IN wide, with top and bottom flanges not less than 3 IN wide.
   b. Minimum thickness before galvanizing 0.0358 IN (20 GA).
5. Insulation supports.
6. Metal closures and pour stops:
   a. Form to configuration required to provide mortar-tight closures.

F. All roof decking to be galvanized.

1. Galvanized coating for metal deck accessories shall conform to ASTM A653 zinc coating.

G. Galvanized Repair Paint: For repair of damaged galvanized surfaces, comply with Section 09905 - *Painting and Protective Coatings*.

H. Screws: Self-drilling, self-tapping, #12 size minimum sheet metal screws.

I. Miscellaneous Steel Shapes: Comply with ASTM A36.

J. Sheet Metal Accessories: Same material and finish as deck members.

K. Joint Sealing Compound: Nonskinning, gun grade, bulk compound as recommended by deck manufacturer.

L. Flexible Closure Strips for Deck: Vulcanized, closed cell expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE 41.

1. Brittleness temperature: -40°F, ASTM D746.
2. Flammability resistance: Self-extinguishing.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install roof deck units and accessories as indicated in accordance with manufacturer's recommendations, final approved shop drawings and as specified herein.

B. Do not start placement of roof deck units until all supporting members are installed complete.
   1. Locate deck bundles to prevent overloading of structure.

C. Do not overload supporting members. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting code or stated design loads.

D. Place each deck unit on supporting structural frame, adjust to final position, and accurately align with ends bearing on supporting members.
   1. Lap units at ends no less than 2 IN.
   2. Do not stretch or contract side-lap interlocks.
   3. Place deck units flat and square and secure to framing without warp or excessive deflection.
   4. Place units in accurate and close alignment for entire length of run and with close registration of flutes of one unit with those of abutting unit.

E. Plug weld sizes specified are effective fusion diameter of welds.
   1. Weld metal shall penetrate all layers of deck material at ends laps and have good fusion to supporting members.
   2. Do not burn through deck.
   3. Prevent over torquing of screw fasteners by using a tool with a depth limiting nosepiece and a clutch.

F. Fastening of Metal Roof Deck:
   1. Secure deck units to supporting frame and side laps as follows:
      a. At all interior supports and at ends of deck use:
         1) For 24 IN wide deck: Three 5/8 IN round plug welds per deck unit.
         2) For 30 and 36 IN wide deck: Four 5/8 IN round plug welds per deck unit.
         3) Install 22 GA deck with welding washers at weld locations.
      b. At perimeter supports, use 5/8 IN round plug welds at 12 IN OC.
      c. At side laps, use #12 hexhead screws at 24 IN OC.

G. Remove and replace decking which is structurally weak or unsound or which has burn holes due to improper welding or which Engineer declares defective.

H. Joint Sealing:
   1. Remove dust, dirt, and moisture from joint surfaces.
   2. Apply sealant in accordance with manufacturer's instructions.

I. Cut and fit deck units and accessories around other work projecting through or adjacent to decking.
   1. Make cutting and fitting neat, square and trim.
      a. Cut deck by mechanical means, not by burning.
   2. Neatly and accurately install reinforcing at all openings except:
      a. Circular openings less than 6 IN DIA.
      b. Rectangular openings having no side dimension greater than 6 IN.
   3. Reinforce openings that have not been framed between 6 IN and 12 IN with 20 GA flat steel sheet 12 IN greater in each dimension than opening. Place sheet around opening and fusion weld to top surface of deck at each corner.

J. Install insulation supports for support of roof insulation.

1. Provide where top surface of roof decking does not occur adjacent to edge and openings as required to completely support roof insulation.
2. Weld into position.

K. Install metal closure strips at all open uncovered ends and edges of roof decking, and in voids between decking and other construction.
1. Weld into position to provide a complete decking installation.
2. Provide flexible closure strips instead of metal closures, at Contractor's option and when approved by Engineer wherever their use will ensure complete closure. Install with elastomeric type adhesive in accordance with written directions and recommendations of manufacturers of closure strips and adhesives.

L. Cant Strips:
1. Weld cant strips to top surface of roof decking at 12 IN OC.
2. Lap end joints not less than 3 IN.

M. Install metal closures to close all openings and gaps between floor decking and other construction, at objects projecting through deck, at locations where deck changes direction, and at open ends of deck units where deck units terminate.
1. Weld into position to provide a complete installation.

N. Clean and Touch Up:
1. Remove all surplus materials and debris from surface of roof deck after installation.
2. Wire brush, clean and paint scarred areas, welds and rust on top surfaces of decking units and supporting steel members in compliance with Section 09905 - *Painting and Protective Coatings*.
3. Touch-up damaged galvanized surfaces with galvanizing repair paint applied in compliance with Section 09905 - *Painting and Protective Coatings*.

3.2 FIELD QUALITY CONTROL

A. Testing:
1. The following test shall be made in the presence of the Engineer employed on the project on the first deck panel to be installed.
2. Place one end of panel over a perimeter support and attach it only to that support with two welds as specified 6 IN apart.
3. The opposite end of the panel shall be moved in plane parallel to the span of the panel until shear distress is noted in the weld.
4. The welds shall be of sufficient quality to cause local distortions in the panel around the welds and show good perimeter contact between the welds and the panel.
5. When the results of this test are satisfactory and approved by the Engineer, the remainder of the deck may be installed using the same weld rod size and type, amperage setting, and procedures used in the tested deck.
6. The remainder of the welds shall be visually inspected. When in the opinion of the Engineer any weld is of poor quality, an additional weld shall be provided adjacent to the rejected weld. It shall be a sufficient distance away from the rejected weld so that the new weld will be done on sound, unburned deck.

END OF SECTION

SECTION 05400

LIGHTGAGE FRAMING

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SECTION 05400

LIGHTGAGE FRAMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. The extent of lightgage framing is shown on the drawings.

B. The types of lightgage metal framing units for the project include the following:
   1. "C" shaped steel studs.

1.3 QUALITY ASSURANCE

A. Component Design: Compute structural properties of studs and joists in accordance with AISC "Specification for the Design of Cold-Formed Steel Structural Members".

1.4 SUBMITTALS

A. Product Data: Lightgage Framing: For information only, submit copies of manufacturer's product information and installation instructions for each item of lightgage framing and accessories. Distribute one additional copy of installation instructions to the Installer.

B. Shop Drawings: Lightgage Framing: Submit shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.

C. Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate supplemental bracing, splices, accessories, and details as may be required for proper installation.

1.5 PRODUCT DELIVERY AND STORAGE

A. Protect metal framing units from rusting and damage. Deliver to the project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Store off the ground in a dry ventilated space or protect with suitable waterproof coverings.

PART 2 – PRODUCTS

2.1 METAL FRAMING

A. System Components: With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as recommended by manufacturer for the applications indicated, as needed to provide a complete metal framing system.

B. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, provide units which meet the requirements for the rated assembly, and which have been tested to meet these requirements.

C. Manufacturer: Provide lightgage metal framing components of the type(s) indicated, produced by one of the following:
   1. U.S. Gypsum.
   2. Dietrich Industries, Inc.

3. Gold Bond.

D. "C" Shaped Steel Studs: Provide 18 gage units meeting ASTM C 955, fabricated from structural quality steel sheet with a minimum yield point of 40,000 psi; ASTM A 446, A 570, or A 611. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.

E. Stud Track: Provide 20 gauge, meeting ASTM C 645 and ASTM A 568 fabricated from structural quality sheet steel with a minimum yield point of 3,000 psi, galvanized finish meeting ASTM A 525.

2.2 FABRICATION

A. General: Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded or with self drilling screws of the size and type recommended or required by the manufacturer for the installation indicated. Perform lifting of prefabricated panels in a manner to prevent damage or distortion in any members in the assembly.

B. Fastenings: Attach similar components by welding or with self tapping screws recommended or required by the manufacturer for the installation indicated. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with the manufacturer. Wire tying of framing components is not permitted.

PART 3 – EXECUTION

3.1 GENERAL

A. Manufacturer's Instructions: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.

B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to the layout at base and tops of studs. Secure tracks as recommended by the stud manufacturer for the type of construction involved, except do not exceed 24" o.c. spacing for nail or power-driven fasteners, nor 16" o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Where stud system abuts structural columns or walls, including masonry walls and concrete walls, anchor ends of stiffeners to supporting structure.

E. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.

3.2 INSTALLATION OF WALL STUD SYSTEM:

A. Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

B. Frame wall openings with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all

around to wall opening frame with steel anchors a minimum of three per jamb, two per head.

C. Frame both sides of expansion and control joints, as shown for the wall system, with a separate stud and do not bridge the joint with components of the stud system.

D. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 4'-6" o.c. Weld at each intersection.

E. Field Paintings: Touch-up shop-applied protective coatings damaged during handling and installation. Use compatible primer for prime coated surfaces; use galvanizing repair paint for galvanized surfaces.

END OF SECTION

SECTION 05505

METAL FABRICATIONS

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SECTION 05505

METAL FABRICATIONS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other sections.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete*.
   4. Section 04220 - *Concrete Masonry*.
   5. Section 05525 - *Steel Railings*.
   6. Section 05522 - *Aluminum Railings*.
   7. Section 09905 - *Painting and Protective Coatings*.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. SAS-30, Specifications for Aluminum Structures.
   2. American Institute of Steel Construction (AISC):
      a. Specifications for Structural Steel Buildings (referred to herein as AISC specification).
   3. American National Standards Institute (ANSI):
      a. A14.3, Ladders-Fixed-Safety Requirements.
   4. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A47, Standard Specification for Ferritic Malleable Iron Castings.
      c. A48, Standard Specification for Gray Iron Castings.
      d. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      e. A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
      f. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      g. A153, Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      h. A197, Standard Specification for Cupola Malleable Iron.
      i. A307, Standard Specification Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      j. A325, Standard Specification for High-Strength Bolts for Structural Steel Joints.
      k. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
      l. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      m. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
      n. A536, Standard Specification for Ductile Iron Castings.
      o. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      p. A582, Standard Specification for Free-Machining Stainless Steel Bars, Hot-Rolled or Cold-Finished.
      q. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Sheet, Strip, Plate, and Flat Bar.
      r. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
      s. A780, Standard Practice for Repair of Damaged Hot-Dipped Galvanized Coatings.
      t. A786, Standard Specification for Rolled Steel Floor Plate.
      u. A992, Standard Specification for Structural Steel Shapes.
      v. B26, Standard Specification for Aluminum-Alloy Sand Castings.
      w. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

x. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
y. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes.
z. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
aa. F467, Standard Specification for Non-Ferrous Nuts for General Use.
bb. F468, Standard Specification for Non-Ferrous Bolts, Hex Cap Screws, and Studs for General Use.
cc. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

5. American Welding Society (AWS):
   a. A5.1, Specification for Covered Carbon Steel Arc Welding Electrodes.
   b. D1.1, Structural Welding Code Steel.
   c. D1.2, Structural Welding Code Aluminum.
6. National Association of Architectural Metal Manufacturers (NAAMM):
   a. Metal Bar Grating Manual.
   b. Metal Stairs Manual.
7. National Association of Corrosion Engineers (NACE).
8. Research Council on Structural Joints:
   a. Structural Joints Using ASTM A325 or A490 Bolts.
9. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to herein as OSHA standards).

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. Hardware: As defined in ASTM A153.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Fabrication and/or layout drawings:
      a. Submit shop drawings for all fabrications and assemblies.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Division, TRW, Inc.
      b. KSM Division Omark Industries.
      c. Eric/Jones Stud Welding Div.
      d. Or approved equal.
   2. Expansion anchors:
      a. Hilti, Inc.
      b. ITW Ramset-Red Head.
      c. Wej-it.
      d. Or approved equal.
   3. Adhesive anchors:
      a. Hilti, Inc.
      b. ITW Ramset-Red Head.
      c. Or approved equal.
   4. Castings, trench covers and accessories:
      a. Neenah Foundry Co.
      b. Deeter Foundry Co.

c. Barry Craft Construction Casting Co.
d. McKinley Iron Works.
e. Or approved equal.

5. Aluminum ladders:
   a. ALACO Ladder Co.
   b. O'Keeffe's, Inc.
   c. Precision Stair Corporation.
   d. Or approved equal.
6. Ladder accessories:
   a. Bilco.
7. Aluminum Ships Ladder:
   a. O'Keefe's, Inc.
   b. ACL Industries.
   c. Or approved equal.

2.2 MATERIALS

A. Steel, Structural Shapes, and Plate:

1.	W, WT:	ASTM A992, Fy = 50 ksi minimum.
2.	HSS-Square & Rectangular	ASTM A500, Grade B, Fy = 46 ksi minimum
3.	HSS-Round:	ASTM A500, Grade B, Fy = 42 ksi minimum
4.	Steel Pipe:	ASTM A53, Grade B, Fy = 35 ksi minimum
5.	Other Shapes & Plate:	ASTM A36, Fy = 36 ksi minimum
6.	Bolts, high strength:	ASTM A325.
7.	Nuts:	ASTM A563.
	a. Provide washers meeting ASTM F436 with all nuts.	
8.	Bolts:	Unfinished, ASTM A307, Grade A.
	a. Washers and nuts as specified above.	
9.	Anchor bolts:	ASTM A36.
10.	Electrodes for welding steel:	AWS A5.1, E70xx Series.
11.	Steel forgings:	ASTM A668.

B. Stainless Steel:
1. Stainless steel: ASTM A666, Type 304, 304L, Grade A.
2. Stainless steel bolts and nuts: ASTM F593, Type 303 or 304 with minimum yield strength of 30,000 psi and minimum tensile strength of 70,000 psi.

C. Cold-Rolled Steel Sheet: ASTM A366.

D. Aluminum:
1. Rolled shapes and extrusions: ASTM B308 or B221.
2. Castings: ASTM B26.
3. Alloys 6061-T6 or 6063-T6 unless specified otherwise in this Section.
4. Aluminum angles, beams, pipes, plates and channels: Alloy 6061-T6.
5. Aluminum weir plates and baffles: Alloy 6061-T6.
6. Aluminum bolts: ASTM F468, alloy 2024 T4.
7. Aluminum nuts: ASTM F467, alloy 2024 T4.
8. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

E. Washers: Same material and alloy as found in accompanying bolts and nuts.

F. Galvanizing: ASTM A123 or A525 with minimum coating of 1.5 OZ per square foot.

G. Expansion Anchors:
1. ASTM A582, Type 304 stainless steel.

H. Adhesive Anchors:
1. Two-part epoxy.
2. ASTM F593, Type 304 stainless steel threaded rod.

I. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.

J. Deformed Bar Anchors: ASTM A496 with a minimum tensile strength of 80,000 psi and a minimum yield strength of 70,000 psi.

K. Iron and Steel Hardware: Galvanized in accordance with ASTM A153 when required to be galvanized.

2.3 MANUFACTURED UNITS

A. Ladders:
1. Material:
   a. Aluminum: 6061-T6 or 6063-T6 alloy.
2. Rails, minimum sizes: 1¼ IN square tubing, 1½ IN nominal diameter pipe or 3 IN wide channel shape, minimum 0.125 IN thick.
   a. Provide ½ x 2½ x minimum 6 IN floor flange welded to rails with punched holes each side for 1/2 IN anchors.
3. Rungs: Minimum 1 IN DIA or 1 IN SQ solid bars with serrated face or applied non-slip finish on all sides unless shown otherwise.
4. Minimum distance from centerline of rung to wall or obstruction: 7 IN.
5. Rung spacing: Uniform, maximum 1 FT. Top rung level with top platform.
6. Design to support minimum 300 LB concentrated vertical load with 150 LB concentrated horizontal load.
   a. Maximum allowable stresses per AISC Specification or AA Specification.
   b. Maximum lateral deflection: Side rail span/300.
7. Designed in accordance with OSHA standards, ANSI A14.3, and applicable building codes.
8. Construction:
   a. Fully welded type.
   b. All welds to be full penetration welds.
9. Finish:
   a. Aluminum: Clear Anodized.
10. Ladder accessories:
    a. Ladder-up Safety Device:
       1) Telescoping tubular steel or aluminum section that automatically locks into place when fully extended.
       2) Non-ferrous corrosion-resistant spring and hardware.
       3) Factory assembled with all hardware necessary for mounting to ladder where indicated on Drawings.
       4) Similar to "Model 2 Ladderup" safety post by Bilco.

B. Bollards:
1. 6 IN DIA Schedule 80 steel pipe.
2. Minimum 48 IN projection above ground.
3. Minimum 48 IN embedment in concrete.
4. Welded on steel headed stud anchors: 1/2 IN DIA as shown on the Drawings.

C. Stair Nosing:
1. Nosings shall be 3" wide, 1/4" thick with 1/2" lip.
2. The base shall consist of heat treated extruded aluminum alloy 6063-T6.
3. The abrasive filler shall consist of a mixture of aluminum oxide and silicon carbide granules in an epoxy matrix locked into the extruded channels of the base.
4. The abrasive ribs shall project a minimum of 1/16" above the extruded channels.
5. Provide with two integral anchors, continuous the full length of the nosings.
6. Nosings shall terminate not more than 4" from ends of steps.

D. Stairs - Grating: Fabricated as indicated.
1. Treads: Grating treads as specified with exception that nosing shall have integral corrugated non-slip edge.
2. Landings: Grating as specified.
3. Fabricate and design stair, landing assembly, and connections to support a 1000 LB concentrated, moving load or 100 psf uniform live load, whichever requires the stronger component.
4. Fabricate and design stair components in accordance with NAAMM Metal Stairs Manual.
5. Design, fabricate, and install in compliance with applicable codes.
6. Material:

a. Aluminum: Alloy 6061-T6 or 6063-T6.

E. Stairs, Steel Pan: Fabricated as indicated.
1. Treads: Minimum 14 GA pans with self-furring metal lath welded in pan.
2. Risers: Minimum 14 GA.
3. Landings: minimum 10 GA pans with angle supports as required.
4. Fabricate and design stair and landing assembly to support a 1000 LB concentrated moving load or 100 psf uniform live load, whichever requires stronger component.
5. Fabricate and design stair components in accordance with NAAMM Metal Stairs Manual.
6. Design, fabricate, and install in compliance with applicable codes.
7. Form surface of nosings with slip-resistant materials or provide separate slip-resistant nosings.
8. Handrails and guardrails: Refer to Section 05522 - Aluminum Railings.
9. Hot-dip galvanized entire assembly after fabrication with minimum 1.5 OZ zinc coating.

F. Steel Pipe Railings: See Specification Section 05525 - *Steel Railings*.

G. Aluminum Pipe Railings: See Section 05522 - *Aluminum Railings*.

H. Loose Bearing Plates:
1. Provide for steel items bearing on masonry or concrete bearing plates to have ½" DIA x 6" long welded headed studs and shall be imbedded in masonry or concrete as shown on the Drawings.

I. Loose steel lintels:
1. Fabricate to sizes shown.

J. Miscellaneous Steel Trim:
1. Fabricate to shapes and sizes as required for profiles shown; continuous welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages; coordinate assembly and installation with other work.

2.4 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, sharp angles, and smooth curves.

C. Drill or punch holes with smooth edges.

D. Weld Permanent Shop Connections:
1. Welds to be continuous fillet type unless indicated otherwise.
2. Full penetration butt weld bends in stair and ladder stringers.
3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1.
4. Weld aluminum in accordance with AWS D1.2.
5. Grind smooth welds that will be exposed.

E. Conceal fastenings where practicable.

F. Punch or drill for field connections and for attachment of work by other trades.

G. Fabricate work in shop in as large assemblies as is practicable.

H. Finishes:
1. Aluminum: Mill finished unless scheduled or otherwise specified or, if approved, finished in manufacturer's standard.
a. Coat surfaces in contact with dissimilar materials. See Section 09905 - *Painting and Protective Coatings*.
2. See Section 09905 - *Painting and Protective Coatings* for preparation and painting of ferrous metals and other surfaces.

I. Fabricate grating, stairs, ladders, and accessories using aluminum unless shown otherwise on Drawings.

J. Completely shop assemble alternating tread stair.

PART 3 – EXECUTION

3.1 PREPARATION

A. Prior to installation, inspect and verify condition of substrate. Installation of product constitutes installer's acceptance of substrate condition for product compatibility.

B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

3.2 INSTALLATION

A. Set metal work level, true to line, plumb.

B. Shim and grout as necessary.

C. Bolt Field Connections: Where practicable, conceal fastenings. Grind welds smooth where field welding is required.

D. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 IN DIA high strength bolts.
   2. Connect aluminum to aluminum with 3/4 IN DIA aluminum bolts.
   3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts. Provide dissimilar metals protection.
   4. Connect aluminum and steel members to concrete and masonry using 3/4 IN DIA stainless steel expansion bolts unless shown otherwise. Provide dissimilar materials protection.
      a. Expansion bolts to have a minimum embedment of 4 IN into concrete and masonry unless indicated otherwise on Drawings.

E. Tighten ASTM A325 high-strength bolts in accordance with Section 8 of ASTM A325 Standard for Structural Joints.
   1. Provide hardened washers for all ASTM A325 bolts. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

F. Secure metal to wood with lag screws of adequate size with appropriate washers.

G. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing. Provide full penetration welded splices where continuity is required.

H. Provide each fabricated item complete with attachment devices as indicated or required to install.

I. Anchor aluminum and metal work so that work will not be distorted nor fasteners overstressed from expansion and contraction.

J. Tie anchor bolts in position to embedded reinforcing steel with wire. Tack welding prohibited. Coat bolt threads and nuts with heavy coat of clean grease. Anchor bolt location tolerance: 1/16 IN. Provide steel templates for all column anchor bolts.

K. Install bollards in concrete as detailed. Fill with concrete and round off at top of pipe.

L. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor. Keep screw holes clean and ready to receive screws.

M. Prepare and paint ferrous metals in accordance with Section 09905 - *Painting and Protective Coatings*.

N. Coat aluminum surfaces in contact with dissimilar materials in accordance with Section 09905 - *Painting and Protective Coatings.*

O. Repair damaged galvanized surfaces in accordance with ASTM A780.

END OF SECTION

SECTION 05522

ALUMINUM RAILINGS

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SECTION 05522

ALUMINUM RAILINGS

1.1 SUMMARY

A. Section Includes:
1. Component aluminum railing systems including fittings, anchor, bases, and accessories.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 05505 - *Metal Fabrications*.
4. Section 09905 - *Painting and Protective Coatings*.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Architectural Manufacturer's Association (AAMA):
   a. 605.2, Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
2. American Society of Mechanical Engineer (ASME):
   a. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
3. American Society for Testing and Materials (ASTM):
   a. B108, Standard Specification for Aluminum-Alloy Permanent Mold Castings.
   b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   c. B211, Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
   d. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
   e. B241, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
   f. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to herein as OSHA standards).
5. Provide rails complying with the Virginia Uniform Statewide Building Code and OSHA Regulations.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals*.
2. Plan showing profile and location of each railing, and type of anchorage.
3. Component connection details.
4. Product technical data including:
   a. Acknowledgment that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation details.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Component railing systems:
   a. Thompson Fabricating.

b. Hollaender Corporation.
c. Alumaguard.
d. Or approved equal.

B. Submit requests for substitutions in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Pipe: 6063-T6 aluminum, ASTM B241, Schedule 40.

B. Sheet and Plate: 6063-T6 aluminum, ASTM B209.

C. Bars, Rods, Shapes and Tubes: 6063-T6 aluminum, ASTM B221.

D. Woven Wire Mesh Panel Inserts: 6063-T6 aluminum, ASTM B211.

E. Cast Fittings: Aluminum, ASTM B108.

F. Fasteners: Stainless steel, ASTM F593, Type 303, 304, or 305 with minimum yield strength of 30,000 psi and minimum tensile strength of 70,000 psi.

2.3 FABRICATION

A. General:
1. Fabricate smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
2. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
   a. Ease exposed edges to a radius of approximately 1/32 IN.
3. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
4. Provide for anchorage of type indicated on Drawings or as required by field conditions.
5. Design railing and anchorage to withstand a 200 LB force applied at any point, in any direction, without failure or permanent set.
6. Custom fabricate pipe railings to dimensions and profiles indicated on Drawings.
   a. Fabricate railings of minimum 1½ IN ID aluminum pipe.
   b. Provide toeboards except where indicated otherwise on Drawings.
7. Fit exposed ends of handrails with solid terminations.
8. Handrail shall be made of pipe and fittings mechanically fastened with stainless steel hardware. Glued and pop-riveted connections are not acceptable.
9. Preassemble items in shop to greatest extent possible, with railing lengths not exceeding 24 FT.
10. All corners and intersections to be supported directly on a post.

B. Finish: AAMA 605.2 AA M10C22A31 clear anodized.

C. Expansion Joints:
1. Allow thermal expansion and contraction of railing while still meeting design loading requirements.

D. Woven Wire Mesh Panel Inserts (Infill Panel):
1. Mesh Pattern: Square.
2. Mesh size: 1½ IN.
3. Mesh fabric: Aluminum, minimum 0.162 IN DIA.
4. Frame: 1 IN x 1/2 IN aluminum channel.
5. Panel sizes as shown on drawings.
6. Finish: Match other guardrail/handrail components
7. Connection method: Bolted.

E. Weep Holes:
1. Fabricate 1/4 IN DIA weep holes in railing 1 IN above walkway surface.

2. Provide in all exterior vertical posts set in concrete or otherwise closed at bottom.
3. Provide at all other low spots in railing system.

F. Toe Boards (Kick Plates):
1. Shall conform to OSHA standards.
2. Minimum 4 IN high.
3. Provide as shown on Drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide component type railings.
1. All component railings shall have mechanical fastenings.

B. Set work accurately in location and elevation.

C. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
1. Space posts not more than 6 FT on center.
2. Space wall brackets not more than 5 FT on center.

D. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.

E. Provide anchorage for posts in the following manner:
1. Top of concrete walls, slabs, walkways, stairs and removable railing sections:
   a. Provide 1/2 IN x 2½ IN x 6 IN aluminum component floor flange with predrilled holes for bolting to concrete.
   b. Secure floor flanges with ½ IN min. stainless steel expansion anchors with sufficient spacing, edge distance and embedment that the full anchor pull-out strength can be developed.
2. Metal stair stringers, walkways and platforms:
   a. Furnish posts with minimum 1/2 IN x 2½ IN x 6 IN aluminum floor flange, welded to post, with predrilled holes for bolting to surface.
3. Post anchors shall be attached to vertical concrete walls where possible. Form or core-drill for tube recess holes in concrete will not be accepted.

F. Set toe boards ¼ IN above walking surface and mount to each post. Provide expansion joints midway between each post.

G. Anchor handrails to walls with wall brackets.
1. Provide brackets with not less than 1½ IN projection from finish wall surface to wall side of handrail.
2. Provide flush-type wall return fittings at handrail ends.

H. Anchor wall brackets with 1/2 IN stainless steel drop-in anchors with stainless steel hex head bolts.

I. Anchor railings to beams and stair stringers with minimum 1/2 IN stainless steel bolts, nuts, and washers.

J. Coat aluminum in contact with dissimilar metal or concrete in accordance with Section 09905 - *Painting and Protective Coatings*.

K. Provide railings as required for stair construction identified in Section 05505 - *Metal Fabrications*.

L. Attach woven wire mesh panel inserts to main railing frame with 1/2 IN stainless steel bolts, nuts and washers.

END OF SECTION

SECTION 05525

STEEL RAILINGS

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SECTION 05525

STEEL RAILINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel railings.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 05505 - Metal Fabrications.
   4. Section 07900 - *Joint Sealants.*
   5. Section 09905 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Structural Steel.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      c. A123, Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A153, Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      f. A392 Standard Specifications for Zinc-Coated Steel Chain Link Fence Fabric.
      g. A525, Standard Specifications for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
      h. {A780, Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings}.
   2. American Welding Society (AWS):
      a. D1.1, Structural Welding Code Steel.
   3. Qualify welding procedures and welding operators in accordance with AWS.
   4. U S Department of Labor, Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to herein as OSHA standards).
   5. Provide rails complying with the Local Building Code and OSHA Regulations.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.
   2. Plan showing profile and location of each railing, and type of anchorage system.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Non-shrink Grout:
   a. Super Por-Rok by CGM Incorporated.
   b. Master-Flow 713 Plus by BASF Chemical Company/Master Builders.
   c. SikaGrout 212 by the Sika Corporation.
   d. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Pipe: ASTM A53, Types E or S, Grade B.

B. Steel Sheet and Plate: ASTM A36.

C. Fasteners: Steel, ASTM A307, Grade A, hot-dipped galvanized in accordance with ASTM A153.

D. Sleeves: 4 IN steel pipe, ASTM A53, Type E or S, Grade B, with ASTM A36 steel plate welded to bottom.

E. Non-Shrink Setting Cement: Non-corrosive, non-shrink, exterior grade grout.

2.3 FABRICATION

A. General:
1. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
   a. Remove blemishes by grinding and buffing or by welding and grinding, prior to cleaning, treating and application of surface finishes.
2. Form exposed work with smooth, short radius bends, accurate angles and surfaces and straight edges.
   a. Ease exposed edges to a radius of approximately 1/32 IN unless otherwise indicated.
   b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
3. Form exposed connections with flush, smooth, hairline joints, using galvanized steel splice locks to splice sections together or by welding. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
4. Provide for anchorage of type indicated and required, coordinated with supporting structure.
   a. In place units to be capable of withstanding a 200 LB force applied at any point, in any direction, failure or permanent set.
5. Custom fabricate pipe railings to dimensions and details indicated and required.
   a. Fabricate railings of minimum 1½ IN ID steel pipe.
   b. Where details are not indicated, set horizontal rails to requirements of the Building Code.
   c. Provide 1/4 IN x 4 IN high toeboards at elevated walkways and platforms, where indicated and required by Building Code.
6. Return ends of handrails to wall.
7. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.
8. Railing finish: Hot-dipped galvanized after fabrication, ASTM A123. Minimum 1.80 OZ zinc coating.
9. Sleeves: Hot-dipped galvanized after fabrication to ASTM A123. Minimum 1.80 OZ zinc coating.

B. Welded Railings:
1. All exposed welds to be ground and buffed smooth and flush to match and blend with adjoining surfaces. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.

C. Install weeps to drain water from railing at exterior and high humidity conditions.
   1. Drill 1/4 IN weep hole in railing 1 IN above walkway surface at bottom of posts set in concrete or otherwise closed at bottom, and at other low points where moisture can collect.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Set work accurately in location, alignment and elevation, plumb, level, and true. Measure from established lines and items which are to be built into concrete, masonry or similar construction.

C. Adjust railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
   1. Space posts not more than 8 FT on centers.
   2. Plumb posts in each direction.
   3. Space wall brackets not more than 6 FT on center.

D. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.

E. Provide anchorage for posts in the following manner:
   1. Removable railing sections, metal stair stringers and metal framing:
      a. Provide 1/4 IN x 2½ IN x 6 IN floor flange welded to post with predrilled holes for bolting to concrete or supporting member.
   2. All other locations: Furnish posts with steel sleeves imbedded in concrete or masonry. Fasten posts inserted into steel sleeves with non-metallic, non-shrink grout.
   3. Provide 1/4 x 2½ x 6 IN "L" shaped floor flange at corners with predrilled holes in each leg of the "L."

F. Where indicated, provide removable railing sections.

G. Secure handrails to walls by means of wall brackets, with wall return fitting at handrail ends.
   1. Provide brackets with not less than 1½ IN projection from finish wall surface to wall side of handrail.
   2. Install flush-type wall return fittings.

H. Secure railings to building construction with 1/2 IN zinc alloy drop in anchors with hot-dipped galvanized steel hex head bolts.

I. Fasten railings to beams and stair stringers with minimum 1/2 IN hot-dipped galvanized steel bolts, nuts and washers.

J. Repair damaged galvanized surfaces in accordance with ASTM A780.

K. Prepare and paint railings in accordance with Section 09905 - *Painting and Protective Coatings*.

L. Provide railings as required for stair identified in Section 05505 - *Metal Fabrications*.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

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SECTION 06100

ROUGH CARPENTRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and General Requirements, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. The extent of the carpentry work is shown on the Drawings and in schedules.

1.3 QUALITY ASSURANCE

A. General Carpentry Materials:
   1. American Softwood Lumber Standard PS 20 (U.S. Dept. Comm.), S4S, 19 percent moisture at time of dressing, except as otherwise indicated. Each piece of lumber and plywood shall be grade marked.

B. Plywood Standard:
   1. Construction and Industrial PS 1 (U.S. Dept. Comm.), type and grade as indicated. Provide plywood bearing DFPA or APA grade trademark.

C. Preservative Pressure-Treated Wood:
   1. AWPB LP-2, pressure-treated with water-borne preservatives. Kiln-dry to 15% moisture content after treatment, except for wood in contact with ground.
   2. Treat cants, nailers, blocking, stripping, and similar items in conjunction with roofing, flashing, vapor barriers, and waterproofing.
   3. Treat sills, sleepers, blocking, furring, stripping, and similar items in direct contact with masonry, stonework, or concrete.
   4. Treat ground-contact and water-immersed wood items in accordance with standard for ground contact.

PART 2 – PRODUCTS

2.1 LIGHT FRAMING (2 X 4 AND 2 X 6)

A. "Stud" grade SYP or Fir, or mixed species.

2.2 PLYWOOD ROOF SHEATHING

A. C-D Int.-APA, exterior glue, tongue and groove, 5/8" thick minimum. At Contractor's option, provide square edge sheathing with plywood sheathing clips, spaced as recommended by the manufacturer.

2.3 PLYWOOD BACKING PANELS

A. For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, not less than 15/32 inch thick.

2.4 STRUCTURAL WOOD FASTENERS

A. 18 gauge zinc coated steel of the sizes and types indicated or required.

PART 3 – EXECUTION

3.1 CARPENTRY INSTALLATION

A. Standards: Except as otherwise indicated, comply with "Manual of House Framing" by Nat. Forest Prod. Assoc., including nailing, firestopping, anchorage, framing and bracing.

B. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed, and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until satisfactory conditions have been corrected in a manner acceptable to the Installer.

C. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with a minimum of joints or optimum jointing arrangement.

D. Fit carpentry work to other work. Scribe, cope and miter for accurate fit.

E. Set carpentry work accurately to required levels and lines with members plumb and true.

F. Securely attach carpentry to substrates by anchoring and fastening as shown or as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.

3.2 WOOD FURRING

A. 1 x 2, except as otherwise shown. Level furring to tolerance of 1/8" in 10"-0".

3.3 WOOD GROUNDS, NAILERS, AND BLOCKING

A. Provide wherever shown and where required for screening or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

D. Provide blocking in stud walls for the installation of toilet accessories. Coordinate blocking locations with mounting heights for each type accessory. Verify location with the Architect prior to installation.

E. Provide blocking in stud walls for the installation of casework. Coordinate blocking locations with details and casework layouts.

END OF SECTION

SECTION 06160

SHEATHING

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SECTION 06160

SHEATHING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Wall sheathing.
   2. Roof sheathing.
   3. Building wrap.

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. Research/Evaluation Reports: For the following:
   1. Preservative-treated plywood.
   2. Fire-retardant-treated plywood.
   3. Foam-plastic sheathing.
   4. Building wrap.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 – PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1.

2.2 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

2.3 ROOF SHEATHING

A. Fiberglass-Mat Faced Gypsum Roof Board:

   1. Thickness: 5/8 inch.
   2. Width: 4 feet.
   3. Length: 8 feet.
   4. Weight: 2.5 psf.
   5. Surfacing: Fiberglass mat with low perm coating.
   6. Flexural Strength, Parallel (ASTM C473): 100 lbf, minimum.
   7. Flute Span (ASTM E661): 8 inches.
   8. Permeance (ASTM E96): Not more than 2 perms.
   9. R-Value (ASTM C518): Not less than 0.67.
   10. Water Absorption (ASTM C1177): Less than 10 percent of weight.
   11. Compressive Strength (Applicable Sections of ASTM C472): 500 - 900 pounds per square inch.
   12. Surface Water Absorption (ASTM C473): Not more than 1 gram.
   13. Basis of Design Product:
       a. DensDeck DuraGuard, Georgia-Pacific Gypsum.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated.
   1. For wall and roof sheathing panels, provide fasteners with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.5 WEATHER-RESISTANT SHEATHING PAPER

A. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

B. Building-Wrap Tape: Tape recommended by building-wrap manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

B. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that exclude exterior moisture.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
   1. Comply with "Code Plus" installation provisions in guide referenced in paragraph above.

B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Screw to metal framing.

C. Building Wrap: Comply with manufacturer's written instructions.
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

END OF SECTION

SECTION 06164

GYPSUM SHEATHING

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SECTION 06164

GYPSUM SHEATHING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Fiberglass-mat faced, moisture resistant gypsum sheathing.

B. Related Sections:
   1. Section 06105 Miscellaneous Carpentry.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
   2. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
   3. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
   4. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.
   5. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
   6. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for each product specified.

1.4 WARRANTY

A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay).

B. Manufacturer's Warranty:
   1. Five years against manufacturing defects.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177; Basis-of-Design DensGlass Gold, Georgia-Pacific Gypsum.
   1. Thickness: 5/8 inch.
   2. Width: 4 feet.
   3. Length: 8 feet.
   4. Weight: 1900 pounds per M square feet.
   5. Edges: Square.
   6. Surfacing: Coated fiberglass mat on face, back, and long edges.
   7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 540 pounds per square foot, dry.
   8. Flexural Strength, Parallel (ASTM C473): 80 lbf, parallel.
   9. Humidified Deflection (ASTM C1177): Not more than 1/4 inch.
   10. Permeance (ASTM E96): 23 perms.
   11. R-Value (ASTM C518): 0.56.

2.2 ACCESSORIES

A. Screws: ASTM C1002, corrosion resistant treated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Inspection: Verify that project conditions and substrates are acceptable, to the installer, to begin installation of work of this section.

3.2 INSTALLATION

A. General: In accordance with ASTM C1280 and the manufacturer's recommendations.

3.3 PROTECTION

A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION

SECTION 06200

ARCHITECTURAL WOODWORK

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SECTION 06200

ARCHITECTURAL WOODWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL STANDARD

A. Comply with applicable "Architectural Woodwork Quality Standards" by AWI. Architectural woodwork is defined to include (in addition to items so designated on drawings) miscellaneous exposed wood members commonly known as "Finish Carpentry" or "Millwork".

1.3 SUBMITTALS

A. Submit complete shop drawings for custom-designed interior woodwork, including casework, cabinetwork, and trim.

B. Submit finished samples of counter top.

C. Quality Certification: Submit manufacturer's (Fabricator's) certification, stating that the fabricated work meets the woodwork grade(s) specified.

1.4 LABELS AND MARKINGS

A. Quality Marking: Mark each unit of architectural woodwork with mill's or Fabricator's identification and grade mark, located on surfaces which will not be exposed after installation unless indicated otherwise above.

1.5 SHOP DRAWINGS

A. Submit shop drawings at 1-1/2" = 1-0" scale showing location of each item, dimensioned plans and elevations, large scale details at 3" = 1'-0" minimum, attachment devices and other components.

PART 2 – PRODUCTS

2.1 BASIC MATERIALS AND FABRICATION METHODS

A. General: Except as otherwise indicated, comply with following requirements for architectural woodwork not specifically indicated as prefabricated or prefinished standard products.

B. Wood Moisture Content: Provide kiln-dried (KD) lumber with an average content range of 6% to 11% for interior work. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed the following:

1. Interior Wood Finish: 5%-10% for mild regions (as defined by AWI).

C. Quality Standards: For following types of architectural woodwork, comply with indicated standards as applicable:

1. Casework and Countertops: AWI Section 400.

D. Design and Construction Features: Comply with details shown for profile and construction of architectural woodwork; and, where not otherwise shown, comply with applicable Quality Standards. Fabricator's alternate details may be applied following approval of

Architect/Engineer. No particle board or hardboard shall be allowed under this Section, except for laminated countertops.

2.2 CASEWORK/CABINETS

A. Cabinet Fronts: Solid Select Red Oak, minimum thickness 11/16"

B. Cabinet Doors: Plain-sliced red oak veneer plywood, minimum 11/16" thick. Reverse bevel may be used in lieu of door pull hardware at Contractor's option.

C. Cabinet Drawers:
   1. Drawer Face: Plain-sliced red oak veneer plywood, minimum 11/16" thick. Reverse bevel may be used in lieu of drawer pull hardware at Contractor's option.
   2. Drawer Sides and Back: Minimum 1/2" thick Birch or Fir.
   3. Drawer Bottom: Minimum 1/4" plywood.
   4. Sides shall be dadoed, rabbeted, or dovetailed to receive the front and back members of the drawer box. No butt joints will be accepted.
   5. Bottoms shall be dadoed and glued into drawer box.

D. Cabinet Sides, Backs, Tops, Bottoms:
   1. All cabinet construction shall be minimum 1/2" plywood. Exposed plywood shall have birch veneer finish.
   2. Tops and bottoms shall be dadoed, glued, and stapled into sides and face frames.
   3. Backs shall be dadoed or rabbeted, glued and stapled into end panels.

E. Shelves: Minimum 5/8" plywood with hardwood edge band on exposed edge.

F. Toe Boards: All toe boards shall be 1/2" pressure treated wood.

G. Countertops:
   a. Phenolic resin, ¾" thick with pre-molded sinks.
   b. Plastic Laminate: NEMA No. Ldl. Class I (high pressure); 0.062" general purpose type for counter tops, 0.032" vertical-surface type for cabinetwork, and 0.020" back-up sheets for concealed back face where required. Provide color, pattern, texture, and sheen as selected by Architect from manufacturer's standard.

H. Hardware:
   1. Drawer Slides: Knape & Vogt 1100, or Grant 328, full extension slides, 50 lb. capacity.
   2. Cabinet Door/Drawer Pulls, Surface: Engineered Products #MC-402 Stanley 4487, or Baldwin 4676, finish to be selected. Not applicable where reverse bevel doors and drawers are used.
   3. Spring Cabinet Hinges: Hinges to return the cabinet door to closed position after it reaches the final 1/4 of its swing. No springs shall be visible from the face of the cabinet. Finish shall be weathered bronze.

2.3 MANUFACTURED CASEWORK

A. Contractor has the option of furnishing factory manufactured casework. Casework must be quality of the above specification.

2.4 FINISH FOR ARCHITECTURAL WOODWORK

A. General: The entire finish of architectural woodwork is work of this section, regardless of whether shop applied or applied after installation.

B. Preparations for Finishing: Comply with AWI Quality Standards, Section 1500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

C. Shop Finishing: To the greatest extent possible, finish architectural woodwork at shop or factory. Defer only final tough-up, cleaning and polishing for time after delivery and installation.

D. Transparent Finish - General Finish Standard: AWI Finish System No. 3, Premium Grade, open grain finish.
   1. Shop Application: Stain and sealer (match approved sample for color).
   2. Final Finish: Sanding, followed by two coats of clear alkyd-urea conversion varnish, rubbed to medium sheen.

PART 3 – EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

3.2 JOB CONDITIONS

A. Conditioning: Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity conditions.

3.3 INSPECTION

A. Examination: The Installer must examine substrates and conditions under which work is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.4 INSTALLATION

A. Install the work plumb level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops); and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offsets in revealed adjoining surfaces.

B. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

C. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nail for exposed nailings, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

D. Casework: Install without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and to

provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

E. Countertops: Anchor securely to base units and other support systems as indicated.

3.5 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Repair damaged and defective woodwork wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.

D. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.

E. Protection:

1. Installer of architectural woodwork shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.
2. Cover completed work with 4-mil polyethylene film protective enclosure, applied in a manner which will allow easy removal and without damage to woodwork or adjoining work. Remove cover immediately before time of final acceptance.

END OF SECTION

SECTION 06610

FIBERGLASS FABRICATIONS

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SECTION 06610

FIBERGLASS FABRICATIONS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fiberglass structural shapes, railings, grating, stairs, ladders, and tank covers
   2. The scope of this specification shall include labor and materials for fiberglass reinforced plastic (FRP) flat tank covers, which may include, but not be limited to:
      a. Tank cover deck panels.
      b. Structural supports.
      c. Flashing and trim.
      d. Fasteners and anchors.
      e. Bulb gaskets and sealant.
      f. Tank cover accessories and appurtenances indicated on drawings.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. A14.3, Ladders - Fixed - Safety Requirements.
   2. American Society for Testing and Materials (ASTM):
      a. A320, Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service.
      b. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
      c. E84, Test Method for Surface Burning Characteristics of Building Materials.
   3. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to herein as OSHA standards).
   4. All fabrications shall meet requirements of local Code.
   5. FRP Deck Panels: ASTM E72, Strength of Panels for Building Construction

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Fabrication drawings showing location, profile, anchorage and support.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   4. Manufacturer's full line of colors available for each component.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Railings:
   a. International Grating, Inc.
   b. IKG Industries.
   c. Fibergrate.
   d. Strongwell.
   e. Seasafe.
   f. Or approved equal.
2. Grating:
   a. International Grating, Inc.
   b. IKG Industries.
   c. Fibergrate.
   d. Strongwell.
   e. Seasafe.
   f. Or approved equal.
3. Stairs:
   a. IKG Industries.
   b. Fibergrate.
   c. Strongwell.
   d. Seasafe.
   e. Or approved equal.
4. Ladders:
   a. IKG Industries.
   b. Strongwell.
   c. Or approved equal.
5. Structural Shapes:
   a. Stongwell.
   b. Seasafe.
   c. Creative Pultrusions, Inc.
   d. Or approved equal.

2.2 MATERIALS

A. Fiberglass:
   1. Isophythalic polyester resin with fiberglass reinforcing.
   2. UV resistant.

B. Fasteners, Clips, Saddles, and Miscellaneous Components:
   1. Outside of tanks: 304L stainless steel.
   2. Inside of tanks: 316L stainless steel.

C. Adhesive:
   1. Recommended by manufacturer.

D. Anti-Skid Surfacing:
   1. Manufacturer's standard.

E. Gaskets:
   1. Neoprene.

2.3 FABRICATION

A. General:
   1. Preassemble items in shop to greatest extent possible.

B. Ladders:
   1. Ladders shall be designed to support a minimum 1000 LB concentrated load.
   2. Rungs: Maximum 1 IN wide with non-skid face on all sides.
   3. Rails:
      a. Minimum 3 IN wide channel shape, minimum 0.250 IN thick.

b. Minimum 2 IN square tube, minimum 0.156 IN thick.

4. Wall support brackets: Maximum 6 FT OC vertical spacing and minimum 0.25 IN thick material. Minimum of two (2) per ladder.
5. Maximum distance from centerline of rungs to wall shall be 7 IN.
6. Maximum 1 FT rung spacing.
7. Design in accordance with ANSI A14.3, OSHA and Building Code requirements.

C. Grating:

1. System shall be designed for superimposed live load of 200 psf with a maximum deflection of ¼ IN under a superimposed live load of 100 psf.
2. Minimum depth: 1½ IN.
3. Bar span: Maximum of 1½ IN center to center.
4. Walking surface: Skid resistant.
5. Bearing bars and cross-bars to be fabricated at the same time creating a one-piece type construction.

D. Structural Shapes and Plates:

1. Structural FRP members shall consist of a glass fiber reinforced polyester resin matrix with approximately 50% resin to glass ratio.
2. Mechanical properties assumed during design are shown on the drawings. Manufacturer's proposed section shall not reduce the Factor of Safety for stress (bending, shear, or axial) by more than 10%.
3. Design beam connections to resist a minimum of 55% of the total capacity of the beam.
4. Live load deflection shall not exceed L/360 or 1/2", whichever is more stringent.
5. Total load deflection shall not exceed L/240 or 3/4", whichever is more stringent.

E. Chlorine Contact Tank Baffles:

1. Baffles shall be provided at locations shown on the drawings.
2. Submit complete shop drawings of all size baffles
3. Contractor to field verify dimensions of walls as indicated by columns
4. Baffles shall be constructed to withstand up to 2' of water level differential on either side of the baffles.
5. Baffles shall include a door, operable from either side, with a minimum size of 2.5'x5'. The door shall provide an opening flush with the Chlorine contact tank floor.
6. Any required metal hardware shall be stainless steel
7. Fiberglass material used shall be NSF-61 certified and suitable for use in chlorinated potable water with chlorine levels up to 15 mg/L.
8. No cut sections of fiberglass shall be exposed to the water, if field cutting is utilized, it shall be field coated with an NSF-61 approved fiberglass resin.
9. Baffle wall shall include 19 square feet of open area, regularly distributed throughout seven feet of the height of the baffles.
10. Baffles wall shall extend to within 2" of the lowest structural member above the floor of the chlorine contact tank
11. A portion of the open area shall be on the bottom of the baffle to allow the chlorine contact tank to drain properly. This open area may be in the door.
12. The baffles shall be constructed in such of multiple pieces held together with fiberglass or stainless steel hardware. The pieces of the baffle need to fit through the access doors to the Chlorine contact tank; therefore, all pieces of the baffle walls shall have at least one dimension of 3' or less, and have a maximum length of 12'.
13. Paint all non-moving portions of the baffles with an NSF-61 approved coating.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Set work accurately in location, alignment and elevation, plumb, level, and true. Measure from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

C. File off cut ends of all fiberglass pieces to a 1/32 IN radius.

D. Seal cut ends of all items with catalyzed resin as recommended by manufacturer.

END OF SECTION

SECTION 07100

WATERPROOFING

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SECTION 07100

WATERPROOFING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. The extent of each type of waterproofing work is shown on the drawings.

1.3 QUALITY ASSURANCE

A. Manufacturer: Provide products by a single manufacturer with successful experience in supplying materials required for the work.

B. Installer: A firm which has specialized in installation of the type of water proofing required for this project and which is acceptable to the manufacturer of the primary waterproofing materials.

1.4 SUBMITTALS

A. Manufacturer's Data: Submit specifications, installation instructions and general recommendations by manufacturer of waterproofing materials.

1.5 JOB CONDITIONS

A. Proceed with waterproofing work only after substrate construction and penetrating work have been completed.

B. Installer must examine substrate and conditions under which water- proofing work is to be performed, and notify Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

C. Weather Conditions: Proceed with waterproofing work only when weather conditions comply with manufacturer's recommendations, and will permit materials to be applied in accordance with recommendations of the manufacturer.

PART 2 – PRODUCTS

2.1 FOUNDATION WALL WATERPROOFING

A. Self-Adhesive Moisture Barrier Film: Provide 4-mil polyethylene film with self-adhesive coating of .060" rubberized asphalt. Membrane shall comply with ASTM E 154. Install with lapped joints, sealed with asphalt mastic, in accordance with manufacturer's recommendations.

1. Acceptable products include:
   a. Bituthene; W. R. Grace & Company.
   b. Polyguard #650 Membrane; Polyguard Products Inc.
   c. Plastiwrap; Progress Unlimited

B. Elastomeric Mastic: Manufacturer's standard, compatible with the waterproofing membrane.

C. Drainage Board: Acceptable products include:

1. Insulated drainage board by Geotech Systems Corporation, Sterling, VA, 2" thick. Installation per manufacturer's recommendation.
2. Miradrain prefabricated drainage structure by Mirafi, Inc., Charlotte, NC, 3/4" x 4' x 8'. Installation per manufacturer's recommendation.
3. Enkadrain wall drainage matting by American ENKA Company, Enka, NC. Installation per manufacturer's recommendation.
4. If option 2 or 3 above is used, a protection board of 1" expanded polystyrene insulation shall be applied directly to the waterproofing membrane.

PART 3 – EXECUTION

3.1 PREPARATION OF SUBSTRATE

A. Clean substrate of projections and substances detrimental to the work; comply with recommendations of prime materials manufacturer.

B. Install cant strips and similar accessories as shown, and as recommended by prime materials manufacturer even though not shown.

C. Fill voids, seal joints and apply bond breakers (if any) as recommended by prime materials manufacturer, with particular attention to construction joints.

3.2 INSTALLATION

A. Self-Adhesive Moisture Barrier: Install sheets in accordance with manufacturer's instructions using the recommended primer and by either lapping or butting-and-battening, and cementing seams with type adhesive recommended by manufacturer. Remove seam border of each sheet's anti-stick film where recommended by manufacturer. Bond sheet to vertical substrates with adhesive recommended by manufacturer. Apply drainage/protection board promptly to prevent damage to waterproofing membrane backfilling. Apply compatible adhesive to drainage/protection board to prevent movement or dislocation of board during backfilling operations.

END OF SECTION

SECTION 07162

DAMPPROOFING

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SECTION 07162

DAMPPROOFING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dampproofing.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 3 - CONCRETE.
   4. Division 4 - MASONRY.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. D1227, Standard Specification for Emulsified Asphalt Used As a Protective Coating for Roofing.

B. Qualifications:
   1. Licensed or approved in writing by coating manufacturer.

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. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Warranty.

1.5 WARRANTY

A. Provide written warranty signed jointly by applicator and manufacturer.

B. Warranty for period of 5 years from date of acceptance by Owner.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Dampproofing system:
      a. Karnak 83 or 86 - Karnak Chemical Corp.
      b. Hydrocide 700 or 700B - Sonneborn.
      c. Sealmastic Type 2 or 3 - W.R. Meadows Inc.

d. Or approved equal.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Dampproofing:
1. Asphalt-free fibrated asphalt emulsion coating for trowel, spray or brush application.
2. Primer as recommended by coating manufacturer.
3. ASTM D1227, Type II, Class 1.

PART 3 – EXECUTION

3.1 PREPARATION

3.2 APPLICATION

A. Apply dampproofing to exterior face of exterior walls below grade where indicated as "DAMPPROOFING." Extend coating to finished grade line.

B. Apply two-coat system.

C. Do not backfill for 48 HRS; however, backfilling is to be completed within 7 days of coating application.

D. Provide protection for coating during backfilling operation.

E. Repair any damage to coating caused prior to or during backfilling.

F. Remove coating from adjacent surfaces as required.

3.3 FIELD QUALITY CONTROL

A. Test wet film thickness and comply with listed manufacturer's recommended coverage rates. Apply additional material as required.

END OF SECTION

SECTION 07176

LIQUID WATER REPELLENT

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SECTION 07176

LIQUID WATER REPELLENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Water based silane/siloxane water repellent.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 3 - Concrete.
   4. Section 04210 - *Brick Masonry.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. ASTM E514, Standard Test Method for Water Penetration and Leakage Through Masonry.

B. Mock-Ups:
   1. Product shall be applied to sample wall erected under Section 04210 and test area of existing brick masonry.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Warranty.

B. Miscellaneous Submittals:
   1. See Section 01340.
   2. Letter from manufacturer stating that product is compatible with and will not cause discoloration of existing or new brick masonry units.
   3. Field conducted water spray test results.

1.4 WARRANTY

A. Provide manufacturer's standard 5-year performance warranty.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Liquid water repellent:
      a. BASF Construction Chemicals - Building Systems (Enviroseal Double 7 for Brick).
      b. Or approved equal.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Water based water repellent: Clear, non-staining, non-yellowing, deep penetrating silane/siloxane sealer:
   1. Maximum VOC content: 2.1 lb/gallon.
   2. Water repellency: 94.8 percent reduction in weight gain per ASTM E514.

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect adjacent surfaces not intended to be covered.

B. Clean surfaces to be covered in accordance with manufacturer's recommendations.

C. Make all mortar repairs at least 48 HRS prior to application.

D. Allow masonry surfaces to cure minimum of 10 days prior to application.

3.2 INSTALLATION AND APPLICATION

A. Install products in accordance with manufacturer's instructions.
   1. Apply as much material as required to obtain results required by Article 3.3, but as a minimum, apply material in accordance with manufacturer's recommendations.

B. Apply to existing and newly constructed exterior brick surfaces exposed to view.

3.3 FIELD QUALITY CONTROL

A. Manufacturer or manufacturer's designated representative shall conduct a water spray test to an area of the mock-up wall specified in Section 04210 for a period of 3 HRS. Water from the spray shall impact the wall at a 45-degree angle to the vertical and shall cover an area of not less than 9 SF. If, within 3 HRS, water transmission appears on the inside face of the wall within the test area, the wall shall be recoated.

B. Retest as required.

C. Recoat as required until wall area remains dry within limits of testing procedure.

D. Results of this test shall be used to determine material quantity to be applied per square foot to the building wall.

END OF SECTION

SECTION 07210

BUILDING INSULATION

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SECTION 07210

BUILDING INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Foundation wall insulation and rigid insulation applied to exterior of CMU wall.
   2. Fiberglass batt insulation.
   3. Vapor retarders.
   4. Insulation Accessories.
   5. 5. Foam CMU fill insulation.
   6. 6. Roof Insulation

1.2 SUBMITTALS

A. Product Data and Product test Reports for each product indicated.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

PART 2 – PRODUCTS

2.1 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards and, for preformed units, in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft. (26 kg/cu. m) with maximum flame-spread and smoke-developed indices of 75 and 450, respectively. (For use at perimeter foundation wall locations and at exterior of CMU wall as indicated.)

C. Mineral-fiber blanket insulation consisting of fibers manufactured from glass wool.
   1. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type III, Class A, unfaced with a flame spread rating of 25 or less and a smoke developed rating of 50 or less. R-value as indicated on the drawings. (for use at ceiling locations as indicated on drawings)

D. Foam Insulation at CMU Walls: ASTM E84 for Fire Safety. Flame spread not to exceed 25. Provide performance U-value of .07 and R-value of 14.2 for 8" block. STC rating for block wall with foam insulation shall be STC 53. Water absorption shall not exceed 15% and there shall be no absorption in less than one hour. Installation shall be as per manufacturer's recommendations for applications in exterior CMU walls. (For use as CMU wall insulation fill.)

E. Roof Insulation: Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

2.2 VAPOR RETARDERS

A. Polyethylene Vapor Retarder: ASTM D 4397, 6 mils (0.15 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

2.3 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B. Insulation Baffle: Pre-formed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

2.4 INSULATION FASTENERS

A. Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

B. Wire Hangers: Galvanized wire fabricated into a net or mesh to retain batt insulation hung between trusses.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install insulation to comply with insulation manufacturer's written instructions applicable to products and application indicated. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

B. Install perimeter insulation and exterior CMU insulation on vertical surfaces by setting units in adhesive.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

C. Installation of General Building Insulation: Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
   1. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant.
   2. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
      a. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Installation of Vapor Retarders: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
   1. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
   2. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor-retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
   3. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor-retarder manufacturer.
   4. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

5. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

E. Apply foam insulation into cavities indicated to receive insulation, taking care to fill voids completely. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close ports after confirming complete coverage.

END OF SECTION

SECTION 07412

METAL ROOF PANELS - SHEET METAL FLASHING AND TRIM

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SECTION 07412

METAL ROOF PANELS - SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Factory-formed and field-assembled standing-seam metal roof panels.
   2. Sheet Metal Flashing, and Trim.
   3. Gutters, Downspouts, and Splash Blocks.
   4. Snow Guards.

1.3 PERFORMANCE REQUIREMENTS

A. Wind-Uplift Resistance: Comply with UL 580 for wind-uplift resistance class indicated.

B. Uplift Rating: UL 90.

1.4 SUBMITTALS

A. Product Data: For each type of metal roof panel and accessory indicated.

B. Shop Drawings: Show layouts of metal roof panels, including plans, elevations, sections, details, and attachments to other work.

C. Samples: For each exposed finish.

D. Material certificates, Product Test Reports, and Maintenance Data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Provide roof panel attachment clips, cleats, and accessories from the roof panel supplier in order to ensure installation compliance with UL uplift ratings and requirements.

1.6 WARRANTY

A. Special Warranty for Watertightness: Manufacturer's standard 20 year non-prorated watertightness warranty.

B. Verify available warranties for units and components and insert number below.

C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish Warranty Period: 20 years from date of Substantial Completion.

1.7 FIELD QUALITY CONTROL

A. Field Measurements: Where possible, and prior to fabrication of panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

1.8 DELIVERY STORAGE AND HANDLING

A. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.

B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that they will not accumulate water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

PART 2 – PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Surface: Smooth, flat finish.
3. Exposed Finishes:
   a. High-Performance Organic Finish: thermocured system with fluoropolymer coating containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA with a 20 year finish warranty as specified above.
4. Concealed Finish: White or light-colored acrylic or polyester backer finish.

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; as recommended in writing by metal roof panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, Granular-Faced Sheet: ASTM D 1970, 55 mils (1.4 mm) thick minimum, consisting of glass-fiber-mat reinforcing and SBS-modified asphalt, granule faced, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

B. Felts: ASTM D 226, Type II (No. 30) asphalt-saturated organic felts.

C. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft. (0.24 kg/sq. m), rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, and other suitable fasteners designed to withstand design loads. The use of exposed fasteners is prohibited.

B. *Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil* (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 METAL ROOF PANELS

A. Standing-Seam Metal Roof Panels: Factory-formed, designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include

clips, cleats, pressure plates, and accessories required for weathertight installation. The use of exposed fasteners is prohibited.

B. Basis of Design Manufacturer: Berridge Architectural Metal Panel Products.

C. Roof System: Berridge CEE-LOCK Standing Seam Panel System
   1. Steel Panel Systems: Comply with ASTM E 1514.
   2. Type: Standing seam to be of interlocking "snap-lock" design joint as indicated on Drawings. Comply with manufacturer's written instructions for installation of roof system to comply with UL uplift rating indicated.
   3. Material: Metallic-coated steel sheet, 24 GA.
      a. Exterior Finish: Fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   4. Clips: Floating to accommodate thermal movement.
      a. Material: stainless-steel sheet.
   5. Joint Type: Interlocking "snap-lock" design with vinyl weather inserts.
   6. Panel Coverage: 1'-4-1/2" centerline of seam to centerline of seam.
   7. Panel Height: 1-1/2"
   8. Uplift Rating: UL 90.

2.5 ACCESSORIES

A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
   1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
   2. Continuous one-piece 1-1/2" high Cee-Rib clip attachment: 24 Ga. Galvanized steel. Located at each panel side joint - equal to the length of each adjacent metal roof panel. Provide vinyl weather inserts. Provide #12 pan head screws as required (by manufacturer in writing) to achieve uplift rating indicated.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing, Drip Edge, Trim, Cladding, Ridge Vents, Valley Flashing, and other Sheet Metal Fabrications: Formed from 0.0179-inch- (0.45-mm-) thick, metallic-coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Provide flashing in the shapes and profiles indicated on the drawings. Other locations include eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Roof Curbs: Fabricated from same material as roof panels, minimum 0.048 inch thick; with bottom of skirt profiled to match roof panel profiles, and welded top box and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch-thick, angle-, L-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

D. Vent Pipe Flashing: Pre-molded black EPDM rubber set in mastic with stainless seamless steel worm gear and compression clamp. Provide vent pipe flashing that is compatible with the sheet metal roofing system.

E. Gutters: Formed from 0.0179-inch- (0.45-mm-) thick, metallic-coated steel sheet. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches (900 mm) o.c., fabricated from same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish gutters to match metal roof panels.

F. Downspouts: Formed from 0.0179-inch- (0.45-mm-) thick, metallic-coated steel sheet; in 10-foot- (3-m-) long sections, complete with formed elbows and offsets. Finish downspouts to match metal roof panels.

G. Splash Blocks: Precast concrete splash blocks; 12" x 30" x 3" high.

2.6 SNOW GUARDS

A. Provide non-penetrating snow guards, which have been specifically designed for use with standing seam metal roof systems.
   1. Attachment shall be by milled stainless steel set screws, which clamp the snow guard to the standing seams of the metal roof system.
   2. Snow guard material shall be cast aluminum.
   3. Snow guard shape shall be whale-tail type.
   4. Field verify existing standing seam height and width. Provide and install snow guards which are adequately sized for existing seam height, width, and configuration.
   5. Install snow guards according to manufacturer's current written instructions.
   6. Protect standing seam metal roof, gutter, and all other items from damage during installation of snow guards. Any roofing or associated materials that damaged during installation of the snow guards shall be replaced.

B. Surface-Mounted, Bar-Type Snow Guards: Aluminum rods or bars held in place by stainless-steel clamps attached to the surface or ribs of exposed-fastener, lap-seam metal roof panels.
   1. Finish: To match metal roof panels.
   2. Available Products:
      a. Alpine Snow Guards, Div. of Vermont Slate & Copper Services, Inc.
      b. LMCurbs; S-5! SnoFence.
      c. Riddell & Company, Inc.; Snobar.
      d. Snow Management Systems, a division of Contek, Inc.; Vermont Snowguard.

C. Refer to Drawings for location of each type.

2.7 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile for full length of panel.

C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 – EXECUTION

3.1 PREPARATION

A. Replace existing damaged wood roof sheathing as indicated on the drawings. Install all new woodwork and other carpentry items as indicated on the drawings prior to installation of roofing system.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels where indicated on drawings. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Cover underlayment within 14 days.

B. Apply felt underlayment, wrinkle free, on roof sheathing under metal panels where indicated on the drawings. Apply in a shingle fashion to shed water with end laps of not less than 6 inches staggered 24 inches between courses.

C. Apply slip sheet over underlayment before installing metal roof panels.

3.3 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.
2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
3. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge caps.
4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten closure panels with self-tapping screws.
5. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Steel Roof Panels: Use stainless-steel or galvanized steel fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.

3.4 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed Continuous one-piece 1-1/2" high Cee-Rib clip attachment: at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer to achieve UL I-90 uplift rating.

1. Install continuous clips to supports with self-tapping fasteners.
2. Standing seam to be of interlocking "snap-lock" design joint. Comply with manufacturer' written instructions for method of clipping roof panels together to ensure a weathertight seal, and compliance with UL uplift rating.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
3. 3. Provide elbows at base of downspouts to direct water away from building. Locate splash blocks at all downspouts.

B. Snow Guards: Install snow guards in accordance with manufacturer's written instructions. Attach snow guards to seams only, do not attach snow guards to face of panel.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION

SECTION 07430

ARCHITECTURAL PANELS

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SECTION 07430

ARCHITECTURAL PANELS

PART 1 – GENERAL

1.1 SCOPE

A. Section Includes
1. The extent of panel system work is indicated on the drawings and in these specifications.
2. Panel system requirements include the following components:
   a. Aluminum faced composite panels with mounting system. Panel mounting system including anchorages, shims, furring, fasteners, gaskets and sealants, related flashing adapters, and protective film (as required) for a complete installation.
   b. Wall cladding, parapet coping, column covers, soffit, sills, border, and filler items indicated as integral components of the panel system or as designed.

B. RELATED DOCUMENTS
1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Technical Specification Divisions 2 through 16 apply to this Section.

1.2 QUALITY ASSURANCE

1. Maximum deviation from vertical and horizontal alignment of erected panels: 1/4" in 20' non-accumulative.
2. Panel fabricator/installer shall assume undivided responsibility for all components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.
3. Shop Drawings shall be prepared by the Fabricator of the Cladding systems.
4. Systems shall have been previously tested for Performance criteria specified herein.
5. Panels will be back-cut for bends and the perimeters pattern cut to within .040" plus or minus tolerances through the use of CNC programmable router table or equivalent.

1.3 REFERENCES

A. American Society for Testing and Materials
1. E 331: Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads
2. E 238: Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
3. D 1781: Climbing Drum Peel Test for Adhesives
4. E 84: Surface Burning Characteristics of Building Materials
5. E 162: Surface Flammability of Materials Using a Radiant Heat Energy Source
6. D 3363: Method for Film Hardness by Pencil Test
7. D 2794: Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
8. D 3359: Methods for Measuring Adhesion by Tape Test
9. D 2247: Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
10. B 117: Method of Salt Spray (Fog) Testing
11. D 2244: Calculation of Color Differences from Instrumentally Measured Color Coordinates
12. D 4214: Evaluating the Degree of Chalking of Exterior Paint Films
13. D 822: Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
14. D 1308: Effect of Household Chemicals on Clear and Pigmented Organic Finishes

1.4 SUBMITTALS

A. Submittals:
1. Submittals shall be in conformance with this section and with the general conditions.

B. Samples:
   1. Panel System Assembly: Two samples of typical assembly, 12" x 12" minimum.
   2. Two samples of each color or finish selected, 3" x 4" minimum.

C. Shop Drawings:
   1. Submit shop drawings showing project layout and elevations, fastening and anchoring methods, detail and location of joints, sealants including joints necessary to accommodate thermal movement, trim, flashing, and accessories.

D. Calculations:
   1. Provide calculations or wind load charts prepared by a professional engineer certifying the system's compliance with design pressures for panel deflection and fastener loads.

E. Secondary Supports Design:
   1. Design, fabricate, and install secondary structural components of the metal cladding system (which may be required in conditions of beam or column enclosures, cornices or other three dimensional shapes) with a factor of safety not less than 1.5 (basis for design calculations shall be 1.5 times the maximum design wind pressure), such that failure of any panel component shall not occur at less than 1.5 times the maximum design wind pressure. Failure is defined as breakage, component disengagement, or permanent distortion.

1.5 WARRANTY

A. Submit in accordance with division 1 - closeout submittals.

B. Workmanship Warranty:
   1. Written warranty signed by manufacturer and installer warranting that portions of the work involving metal panels are of good quality, free from defects, and in conformance with the requirements of the Contract Documents. Further guarantee to repair or replace defective work during a one year period following Substantial Completion of the work.
   2. Defective is defined to include failure of the system to meet structural performance requirements and/or permanent deformation resulting from pressures within the design criteria.

C. Finish Warranty:
   1. The Aluminum Composite Material manufacturer shall warrant the finish in accordance with AAMA 2605 for 20 years against Max 5 fade based on ASTM D2244 and Max 8 chalk based on ASTM D4212 and de-lamination of the paint finish. Upon notification of defects within the warranty period, make necessary repairs or replacement at the convenience of the owner.
   2. The Aluminum Composite material manufacturer shall warrant for a period of 5 years the bond integrity of the sheet material.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver units and other components so they will not be subject to damage or deformation. Deliver panel units in crates designated for specific locations on the building as coordinated between GC and installer. Crates shall be able to withstand hoisting loads relevant to the project.

B. Storage: Stack components off the ground/floor on suitable skids in fully enclosed space. Protect against warpage, scratches, damage from moisture, exposure to direct sunlight and other surface contamination.

C. Handling: Exercise care in loading, unloading, storing, and installing units so as to preclude bending, warping, twisting, and surface damage.

PART 2 – PRODUCTS

2.1 PANELS

A. Composite Panels System:
   1. Fabricators offering products which may be incorporated in the work, but are not limited to, the following:
      a. Basis of Design is Metalwërks® Arcwall-ACM by Metal Sales & Service Inc. of Kennett Square, Pa 19348 (800-321-7816 or website: www.metalwerksusa.com)
   2. Continuous Panel Frame:
      a. Extruded aluminum frames are continuous 6063-T6 profiles which are factory assembled with the face skins to make up a panel unit.
      b. Panel frames are mechanically corner keyed to form a monolithic assembly.
      c. Systems relying on ACM sheet material alone with intermittent attachment clips alone for support will not be considered.
   3. Intermediate Panel stiffeners, where required by design loads applied to the panels, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
   4. Panel fasteners: Type 304 Stainless Steel or Cadmium plated fasteners for panel attachment in size and spacing as dictated by structural requirements.
   5. Anchorage system: Shall be designed so that panels are secure yet free floating to accommodate thermal expansion and contraction. Attachment clips will be designed to slide into and mate with continuous panel frame members. Clips are pre-punched and spaced to accommodate structural design requirements.
   6. Panel joints will be sealed in the field with a nominal 5/8" joint sealer consisting of backer rod and caulking as recommended by the panel system supplier to meet system performance requirements.
   7. Panel facing: Panel face skins will be mechanically pattern cut and bend lines back-routed using CNC programmable equipment which will replicate tolerances down to .040" max.

2.2 MATERIALS

A. General:
   1. Facing Material shall be selected from one of the following:
      a. 4mm thick (.158") Polyethylene core aluminum composite material made up of an interior and exterior skin of .020" thick coated aluminum sheets chemically bonded to a polyethylene core as supplied by:
         1) Reynobond® as manufactured by Alcoa Cladding Systems.
         2) Alucobond® as manufactured by Alcan Composites USA.
   2. Physical characteristics of the facing material are as follows:
      a. Bond Integrity: When tested for bond integrity, in accordance with ASTM D 1781 (simulating resistance to panel de-lamination), there shall be no adhesive failure of the bond a) between the core and the skin nor b) cohesive failure of the core itself below the following values:
      b. Peel Strength:
         100 N·mm/mm (22.5 in·lb/in) as manufactured
         100 N·mm/mm (22.5 in·lb/in) after 8 hours in water at 200°F (93°C)
         100 N·mm/mm (22.5 in·lb/in) after 21 days soaking in water at 70°F (21°C)
      c. Fire Performance:
         1) ASTM E 84: Flame spread 0, Smoke developed 0
         2) ASTM E 162: No surface flaming
         3) UBC 17-5: No flame spread along interior face or penetration through the wall assembly.

B. Composition:
   1. Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials.

The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.

C. Aluminum Face Sheets:
   1. Thickness: 0.5mm (0.019") nominal
   2. Alloy: AA3105 H25 Series (Painted material)

D. Panel Weight:
   1. 4mm (0.158"): 5.47 kg/m² (1.12 lb/ft²)

E. Tolerances:
   1. Panel Bow: Maximum 0.8% of any 1828mm (72") panel dimension.
   2. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
   3. Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.
   4. Maximum deviation from panel flatness shall be 1/8" (3.2mm) in 5'0" (1.52m) on panel in any direction for assembled units. (Non-accumulative - No Oil Canning)

2.3 FINISHES

A. Fluoropolymer Two or Three Coat Coating System: Manufacturer's standard two or three coat, thermo-cured system composed of specially formulated inhibitive primer, fluorocarbon color coat, and a clear fluorocarbon topcoat (applicable with three coat system). Both color coat and clear topcoat shall contain not less than 70% polyvinylidene resin by weight in compliance with AAMA 2605 for testing, performance, and application procedures.
   1. Coil coated Kynar® 500 or Hylar® 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene - Alkyl Ether (FEVE) resin in conformance with the general requirements of AAMA 2605.
   2. Standard colors as selected by the Architect/Engineer from manufacturer's standard color charts.

2.4 DESIGN CRITERIA

A. Composite panels shall be capable of withstanding building movements and weather exposures based on the following test standards:
   1. Wind Load:
      a. Panels shall be designed to withstand the Design Wind Load specified herein as 20 PSF. Wind load testing shall be conducted in accordance with ASTM E 330 to obtain the following results.
         1) Normal to the plane of the wall between supports, deflection of the secured perimeter framing members shall not exceed L/175 or ¾" whichever is less.
         2) Normal to the plane of the wall, the maximum panel deflection shall not exceed L/60 of the full span. No permanent deformation of the panel system will be allowed.
      b. Air and Water Infiltration Tests:
         1) If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards:
         2) Air Infiltration - When tested in accordance with ASTM E 283, air infiltration at 1.57 lb/ft² (75 Pa) must not exceed 0.06 ft^3/min. per ft² of wall area (305 cm^3/s per m^2 of wall area).
         3) Water Infiltration - Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. No water infiltration shall occur in any system under a differential static pressure of 6.24 lb/ft² (300 Pa) after 15 minutes of exposure in accordance with ASTM E 331.

2.5 ACCESSORIES

1. Sealants within the panel system shall be as per manufacturer's standards to meet performance requirements.
2. Internal Flashing: sheet metal flashing at base will be produced in the same material finish as the adjacent panels but will be provided in minimum .040" thickness or 24 ga 304 2B Stainless steel.
3. Furring/Supports: Wall panels will be attached to minimum 16 ga. g-90 steel studs or furring.
4. Fasteners: Type 304 Stainless Steel or Cadmium plated as recommended for specific application.

PART 3 – EXECUTION

3.1 INSPECTION

A. Surfaces to receive panels shall be even, smooth, sound, clean, dry and free from defects detrimental to work. Notify contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

1. Erect panels plumb, level, and true.
2. Attachment system shall allow for the free vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F (-29°C to +82°C). Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted.
3. Panels shall be erected in accordance with an approved set of shop drawings.
4. Anchor panels securely and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
5. Conform to panel fabricator's instructions and/or approved shop drawings for installation of concealed fasteners.
6. Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded, and broken members.
7. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance.
8. Separate dissimilar metals where needed to eliminate the possibility of corrosive or electrolytic action between materials.
9. Installation Tolerances: Shim and align panel units within installed tolerances of 1/4 inch in 20 feet, non-cumulative, on level/plumb/slope and location/line as indicated, and within 1/16 inch offset of adjoining faces and of alignment of matching profiles.

3.3 ADJUSTING AND CLEANING

1. Remove and replace panels damaged beyond repair as a direct result of the panel installation.
2. Repair panels with minor damage.
3. Remove protective film after installation.
4. Project finish, after installation.

END OF SECTION

SECTION 07460

SIDING AND TRIM

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SECTION 07460

SIDING AND TRIM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. A. Fiber cement, trims, soffits, molding and accessories.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches (100 by 150 mm), representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Product Warranty: Limited product warranty against manufacturing defects.
   1. Trim for 10 years.

B. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: James Hardie Building Products, Inc;

B. Products by other manufacturers will be accepted subject to compliance with the requirements of the Contract Documents.

2.2 SIDING

A. Code Compliance Requirement for Materials:
   1. National Evaluation Report No. NER 405 (BOCA, ICBO, SBCCI)
   2. US Department of Housing and Urban Development Materials Release 1263d
   3. California DSA PA-019.
   4. Non-asbestos fiber-cement siding where required to be non-combustible shall be tested in accordance with ASTM E136.

B. Trim: Fascia and trim as manufactured by James Hardie Building Products, or equal, 5/4 thickness, smooth texture.

C. Soffit: Soffit panels, vented, Smooth Panel, size as needed.

2.3 FASTENERS

A. Wood Framing Fasteners:
   1. Corrosion resistant nails, length as required for existing conditions and for wind resistance of 90 miles per hour.

2.4 FINISHES

A. Factory Primer: Provide factory applied universal primer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Notify the Architect of any unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION - TRIM

A. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.

B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

C. Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.

D. Maintain clearance between trim and adjacent finished grade.

E. Trim inside corner with single board.

F. Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten trim board to trim board.

G. Allow 1/8 inch gap between trim and siding.

H. Seal gap with high quality, paint-able caulk.

I. Shim frieze board as required to align with corner trim.

J. Install fascia over structural subfascia.

K. Overlay siding with trim at windows, doors and inside corners.

L. Fasten through overlapping boards. Do not nail between lap joints.

3.4 FINISHING

A. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion inspection.

END OF SECTION

SECTION 07920

JOINT SEALANTS

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SECTION 07920

JOINT SEALANTS

1.1 GENERAL

A. Preconstruction Joint-Sealant-Substrate Tests: Submit substrate materials, representative of actual joint surfaces, to joint sealant manufacturer for laboratory testing of joint sealants for adhesion to primed and unprimed substrates and for compatibility with joint substrates and other joint-related materials.

B. Submittals: In addition to Product Data, submit the following:
   1. Samples of each type and color of joint sealant required.

1.2 PRODUCTS

A. Elastomeric Joint Sealants: Subject to compliance with requirements, provide sealants with the following characteristics:
   1. Manufacturers:
      a. Tremco
      b. Pecora
      c. Sonneborn
   2. Multi-component high performance urethanes (exterior building joints):
      a. Multi-component, chemically curing, polyurethane sealant specifically formulated for use in dynamic exterior building joints.
      b. Non-sag general purpose sealant providing durable, flexible, weather tight seals for all types of building joints.
      c. Suitable for use on precast concrete, masonry, metal curtainwall, door and window openings, EIFS, and other exterior building materials.
      d. Suitable for severe outdoor applications subject to intense heat, humidity or ultraviolet exposure.
      e. Minimum of 50 standard colors to choose from, and custom colors to match Architect's sample.
      f. ASTM C920, Type M, Grade NS, Class 25, use NT, M, A, and O.
   3. Multi-component high performance urethanes (horizontal traffic rated joints):
      a. Multi-component, chemically curing, self leveling, pour grade polyurethane joint sealant.
      b. Ideal to resist adverse moisture, abrasion, movement, shear, and deflection in expansion joints.
      c. Suitable for sealing expansion and control joints in parking garages, plazas, terraces, highways, bridges, floors, and sidewalks.
      d. Suitable for continuous water immersion.
      e. Minimum of 5 standard colors to choose from.
      f. ASTM C920, Type M, Grade P, Class 25, use T, M, A, and O.

   4. Silicones (exterior construction subject to linear expansion and shear):
      a. Single-component, moisture curing, low modulus, high performance silicone joint sealant.
      b. Ideal for sealing most demanding dynamically moving joints associated with materials having a high coefficient of linear expansion.
      c. Formulated specifically for expansion, control, and lap joints subject to expansion, compression, transverse and longitudinal movement.
      d. Resists severe wind loading, wind driven rain, snow and sleet. Resistant to acid rain, ozone, ultraviolet light, and extreme temperature variations.
      e. Minimum of 5 standard colors to choose from.
      f. ASTM C920, Type S, Grade NS, Class 25, use NT, M, G, A, and O.
   5. Acrylic Latex (interior caulking applications):
      a. Single-component, pure acrylic latex sealant formulated to provide a fast setting pliable seal with minimum shrinkage.

b. For general purpose interior caulking. Ideal for interior joints that will be painted such as door and window frame perimeters.
c. Suitable for use on vinyl, aluminum, wood, drywall and other interior materials.
d. Mildew resistant for use with bathroom and kitchen fixtures.
e. Paintable in less than 1 hour.
f. ASTM C-834.

B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.

C. Primers: Provide primers recommended by manufacturer in writing for products outlined above.

D. Acrylic-Based Solvent-Release Sealant: ASTM C 1311.

E. Butyl-Rubber-Based Solvent-Release Joint Sealant: ASTM C 1085.

F. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

G. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Type C: Closed-cell material with a surface skin.
2. Type O: Open-cell material.
3. Type B: Bicellular material with a surface skin.

H. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C).

I. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

1.3 EXECUTION

A. General: Comply with joint sealant manufacturer's instructions for products and applications indicated.

B. Sealant Installation Standard: Comply with ASTM C 1193.

END OF SECTION

SECTION 08110

STEEL DOORS AND FRAMES

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes steel doors and frames.

1.2 SUBMITTALS

A. Product Data: For each product indicated. Include door designation, type, level and model, material description, label compliance, fire-resistance ratings, and finishes.

B. Door Schedule. Use same reference designations indicated on Drawings.

1.3 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage. Damaged and rusted doors and frames shall be removed and replaced as directed by the Architect at no additional cost to the Owner.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to promote air circulation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door Products; a United Dominion Company.
2. Curries Company.
3. Steelcraft; a division of Ingersoll-Rand.
4. Or approved equal.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A 526 (ASTM A 526M), commercial quality, or ASTM A 642 (ASTM A 642M), drawing quality, hot-dip galvanized according to ASTM A 525, with A 60 or G 60 (ASTM A 525M, with Z 180 or ZF 180) coating designation, mill phosphatized.

2.3 DOORS

A. Interior Doors: Complying with ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level indicated.
   1. Level 3 and Physical Performance Level A, Model 2 (Seamless) with flush tops and bottoms, galvanized finish.
   2. 16 GA (.053") steel face thickness.
   3. Provide manufacturer's standard kraft honeycomb core.

B. Exterior Doors: Complying with ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level indicated. If more than one level and model are retained, indicate on schedule on Drawings where each is required.
   1. Level 3 and Physical Performance Level A, Model 2 (Seamless) with flush tops and bottoms.
   2. Exterior doors to be galvanized.
   3. 16 GA (.053") steel face thickness.
   4. Provide manufacturer's standard rigid polyurethane core.

2.4 FRAMES

A. General: ANSI A250.8; conceal fastenings, unless otherwise indicated.

B. Frame construction: Fabricate frames with mitered or coped and continuously welded corners.

C. Frame Steel Sheet Thickness:
   1. 16 GA - 0.053-inch- (1.3-mm-) for interior door locations, galvanized.
   2. 14 GA - 0.067-inch- (1.7-mm-) for exterior door locations, galvanized.

D. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.

E. Plaster Guards: 0.016-inch- (0.4-mm-) thick, steel sheet plaster guards or mortar boxes to close off interior of openings.

F. Supports and Anchors: Not less than 0.042-inch- (1.0-mm-) thick zinc-coated steel sheet.
   1. Masonry Wall Anchors: 0.177-inch- (4.5-mm-) diameter, steel wire complying with ASTM A 510 (ASTM A 510M) may be used in place of steel sheet.

G. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Zinc-coat items that are to be built into exterior walls according to ASTM A 153/A 153M, Class C or D as applicable.

2.5 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI A250.8 free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.

B. Exterior Doors: Fabricate doors, panels, and frames from metallic-coated (galvanized) steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

C. Interior Door Faces: Fabricate exposed faces of doors and panels from metallic-coated (galvanized) steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

D. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards as indicated.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

F. Clearances for Fire-Rated Doors: As required by NFPA 80.

G. Door-Edge Profile: Beveled edge.

H. Tolerances: Comply with SDI 117.

I. Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.

J. Reinforce doors and frames to receive all hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

K. Locate hardware as indicated or, if not indicated, according to ANSI A250.8.

L. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- (0.8-mm-) thick steel sheet.
   1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
   2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

2.6 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   1. Wall Anchors: Provide at least three anchors per jamb. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
   2. Fire-Rated Frames: Install according to NFPA 80.

B. Door Installation: Comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G. Fire-Rated Doors: Install within clearances specified in NFPA 80..

C. After installation, remove protective wrappings from doors and frames and touch up prime coat with compatible air-drying primer.

END OF SECTION

SECTION 08305

ACCESS DOORS

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SECTION 08305

ACCESS DOORS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Floor doors.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 11 - Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Underwriters Laboratories, Inc. (UL):
      a. Building Products Directory.

1.3 DEFINITIONS

A. Standard Duty: Will support live load of 150 psf.

B. Heavy Duty: Will support live load of 300 psf.

C. The following acronyms are used on the Drawings to identify floor door types:
   1. SDNF: Standard Duty, Non-draining Frame.
   2. SDDF: Standard Duty, Draining Frame.
   3. HDNF: Heavy Duty, Non-draining Frame.
   4. HDDF: Heavy Duty, Draining Frame.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operations and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers types are acceptable:
   1. Standard duty floor doors:
      a. Non-draining Frames (SDNF).
         1) Bilco Company (Type K or KD modified to meet 300 psf loading requirement).
         2) Babcock Davis Associates (Type B-FHA).
         3) Dur-Red Products (Type SEA or DEA).
         4) Halliday Products (Type S1S or S2S).
         5) Or approved equal.
      b. Draining Frames (SDDF):
         1) Bilco Company (Type J-AL or JD-AL).

2) Babcock Davis Associates (Type B-FGA).
3) Dur-Red Products (Type SLG or DLG).
4) Halliday Products (Type W1S or W2S).
5) Or approved equal.

2. Heavy-duty floor doors:
   a. Non-draining Frames (HDNF):
      1) Bilco Company (Type JAL-H20 or JDAL-H20).
      2) Babcock Davis Associates (Type B-FHA).
      3) Dur-Red Products (Type SEA or DEA).
      4) Halliday Products (Type H1R or H2R).
      5) Or approved equal.
   b. Draining Frames (HDDF):
      1) Bilco Company (Type JAL-H20 or JDAL-H20).
      2) Babcock Davis Associates (Type B-FGA).
      3) Dur-Red Products (Type SLG or DLG).
      4) Halliday Products (Type H1W or H2W).
      5) Or approved equal.

2.2 MANUFACTURED UNITS

A. All Floor Doors:
   1. Frame: 1/4 IN mill finished aluminum.
   2. Bituminous coated in contact with concrete or imbedded in concrete.
   3. Door Plate: Minimum 3/16 IN mill finished aluminum diamond plate.
   4. All Hardware: Type 316 Stainless steel.
   5. Grip Handle: Vinyl.
   6. Fabricate frame with built-in neoprene cushion gaskets and strap anchors bolted to exterior.
   7. Reinforce door(s) with aluminum stiffeners as needed to meet loading requirements.
   8. Bolt hinges to underside of door. Pivot on torsion bars.
   9. Fabricate doors to open to 90 degrees with a spring assist and automatically lock into open position.
   10. Furnish with snap lock and removable grip handle.
   11. Size(s): Refer to Drawings.

B. Non-Draining Frames:
   1. Frame: angle or channel type.

C. Draining Frames:
   1. Frame: channel type.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. When installing floor doors in concrete check that:
   1. All reinforcing displaced by the opening has been installed adjacent to the opening on both sides and in both directions prior to placing concrete.
   2. Diagonal reinforcing bars have been installed at corner of openings prior to placing concrete.
   3. All required drain piping has been installed.

END OF SECTION

SECTION 08331

OVERHEAD COILING DOORS

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SECTION 08331

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section includes the following types of manually and electric-motor-operated overhead coiling doors:
   a. Insulated service doors.
2. Related Sections include the following:
   a. Division 16 Sections for electrical service and connections for powered operators and accessories.

1.3 DEFINITIONS

1. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.4 PERFORMANCE REQUIREMENTS

1. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
   a. Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
2. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles.

1.5 SUBMITTALS

1. Product Data: For each type and size of overhead coiling door and accessory.
2. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.
3. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available for units with factory-applied finishes.

1.6 QUALITY ASSURANCE

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
2. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
   a. Obtain operators and controls from overhead coiling door manufacturer.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 - PRODUCTS

1.7 MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cookson Company.

b. Cornell Iron Works Inc.
c. McKeon Rolling Steel Door Company, Inc.
d. Overhead Door Corp.
e. Raynor.
f. Wayne-Dalton Corp.
g. Windsor Door.
h. Or approved equal.

1.8 DOOR CURTAIN MATERIALS AND CONSTRUCTION

1. Door Curtains: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   a. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 (Z275) coating designation.
      1) Minimum Base-Metal (Uncoated) Thickness: 0.0209 inch.
      2) Flat profile slats.
   b. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.
   c. Inside Curtain Slat Face: To match material of outside metal curtain slat.
2. Endlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
3. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; galvanized, stainless-steel, or aluminum extrusions to suit type of curtain slats.
4. Curtain Jamb Guides for Service Doors: Fabricate curtain jamb guides of steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch thick galvanized steel sections complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

1.9 HOODS AND ACCESSORIES

1. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
   a. Fabricate hoods for steel doors of minimum 0.028-inch thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
   b. Shape: Round.
   c. Exterior-Mounted Door: Fabricate hood with sealant-joint bead profile for applying joint sealant.
2. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch thick, replaceable, continuous sheet secured to inside of hood.
   a. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
   b. In addition, provide replaceable, adjustable, continuous, flexible, 1/8-inch thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.

3. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.
   a. Provide pull-down straps or pole hooks for doors more than 84 inches high.
4. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
   a. Locking Bars: Full-disc cremone type, both jamb sides operable from inside and outside.
   b. Lock cylinder is specified in Division 8 Section "Door Hardware."
5. Chain Lock Keeper: Suitable for padlock.
6. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

1.10 COUNTERBALANCING MECHANISM

1. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
2. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
3. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.
4. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
5. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

1.11 MANUAL DOOR OPERATORS

1. Provide manual chain-hoist operators unless electric door operators are indicated.
2. Chain-Hoist Operator: Provide manual chain-hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and gear-reduction unit with a maximum 35-lbf force for door operation. Provide alloy steel hand chain with chain holder secured to operator guide.

1.12 ELECTRIC DOOR OPERATORS

1. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
2. Comply with NFPA 70.
3. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging chain and sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
4. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
5. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.
6. Door-Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft-type door operator unit consisting of electric motor, drive, and chain and sprocket secondary drive.
7. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1; with overload protection; sized to start, accelerate, and operate door in either direction from any position, at not less

than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or service factor.
   a. Type: Polyphase, medium-induction type.
   b. Service Factor: According to NEMA MG 1, unless otherwise indicated.
   c. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
8. Remote-Control Station: Provide momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
9. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
   a. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
      1) Provide pneumatically or electrically actuated automatic bottom bar.
10. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

1.13 FINISHES, GENERAL

1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.14 STEEL AND GALVANIZED STEEL FINISHES

1. Factory Primer for Field Finish: Manufacturer's standard primer, compatible with field-applied finish according to coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
2. Baked Finish: Manufacturer's standard baked finish consisting of primer and topcoat according to coating manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.
3. Powder-Coat Finish: Manufacturer's standard powder-coat finish consisting of primer and topcoat according to coating manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.
   a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

1.15 INSTALLATION

1. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports.

1.16 ADJUSTING

1. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.

1.17 DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08411

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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SECTION 08411

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Exterior aluminum-framed storefronts.
      a. Glazing is retained mechanically with gaskets on four sides.
   2. Exterior manual-swing aluminum doors.
   3. Exterior aluminum door frames.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
   1. Structural loads.
   2. Thermal movements.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferred to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
      d. Glazing-to-glazing contact.
      e. Noise or vibration created by wind and thermal and structural movements.
      f. Loosening or weakening of fasteners, attachments, and other components.
      g. Sealant failure.
      h. Failure of operating units to function properly.
   4. Comply with all current applicable standards of ASTM, AAMA, ANSI and NAAMM

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples: For each exposed finish.

D. Product test reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Acceptable to manufacturer and capable of preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.5 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.

b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components to function properly.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for aluminum-framed systems is based on **Kawneer Trifab 451**. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. EFCO Corporation.
2. Tubelite Inc.
3. Vistawall Architectural Products.
4. YKK AP America Inc.
5. Or approved equal.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type and as follows:

1. Structural Sealant: ASTM C 1184, neutral-curing silicone formulation compatible with system components with which it comes in contact.
   a. Color: Black.
2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact.
   a. Color: Matching structural sealant.

2.5 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual swing operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width.
   a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
   a. Provide nonremovable glazing stops on outside of door.

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

B. Scheduled Door Hardware: Provide door hardware according to the Door Hardware Schedule at the end of Part 3.

1. Named Manufacturer's Products: Product designation and hardware manufacturer are listed in the Door Hardware Schedule at the end of Part 3 to establish minimum requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware.
   a. Named products are basis-of-design products. Provide named hardware manufacturer's products or comparable products that are equivalent in function and quality and that are recommended and supplied by entrance system manufacturer.

C. Cylinders: As specified in Division 8 Section "Door Hardware."

D. Cylinder Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".

E. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

F. Weather Stripping: Manufacturer's standard replaceable components.
   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

G. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

H. Silencers: BHMA A156.16, Grade 1.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   6. Provisions for field replacement of glazing from interior.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops.

F. Doors: Reinforce doors as required for installing hardware.
   1. At exterior doors, provide weather sweeps applied to door bottoms.

G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Class II, Clear Anodic Finish: AA-M12C22431 (Mechanical Finish: Nonspecular as fabricated; Chemical Finish: Etched, medium matte; anodic coating: architectural coating: architectural class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
   1. Fit joints to produce hairline joints free of burrs and distortion.
   2. Rigidly secure nonmovement joints.
   3. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   4. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Entrances: Install to produce smooth operation and tight fit at contact points.
   1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
   2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install insulation materials as specified in Division 7 Section "Building Insulation."

I. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

J. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
   3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.2 FIELD QUALITY CONTROL

A. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.3 DOOR HARDWARE SCHEDULE

Door Hardware
Single Door No. 1 to have the following:

1 ea.	Single Acting Push/Pulls	CO-12/CP-II	Kawneer	US26D
1	Threshold	½" X 6 ¾" aluminum	Kawneer	Mill finish
[#]	Closing Devices	SC61	Dor-O-Matic	ALUM
1	Cylinder by Hardware supplier			
3	Number of butt hinges, as specified.			

END OF SECTION

SECTION 08441

GLAZED ALUMINUM CURTAIN WALLS

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SECTION 08441

GLAZED ALUMINUM CURTAIN WALLS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

B. Wind Loads: As indicated on structural drawings.

C. Structural-Test Performance: Test according to ASTM E 330 as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: 10 seconds.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

E. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

F. Energy Performance: Glazed aluminum curtain wall shall have certified and labeled energy performance ratings in accordance with NFRC.

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.45 as determined according to NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
   2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
      a. Joinery, including concealed welds.
      b. Anchorage.
      c. Expansion provisions.
      d. Glazing.
      e. Flashing and drainage.

C. Samples: For each type of exposed finish required.

D. Qualification Data: For qualified Installer.

E. Product test reports.

F. Maintenance data.

G. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

D. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
   1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.

1.5 WARRANTY

A. Special Assembly Warranty: Standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 — PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Aluminum Curtain Wall 1600 Wall System 4 - 2-1/4" x 6", inside glazed format or comparable product by one of the following:

1. Arch Aluminum & Glass Co., Inc.
2. EFCO Corporation.
3. Kawneer North America; an Alcoa company.
4. Tubelite.
5. United States Aluminum.
6. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
7. Wausau Window and Wall Systems.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front (inside) glazed format

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.

D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing Sealants: Manufacturer's standard sealants.

2.4 GLAZING

A. Glazing: Comply with Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.5 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components that, when assembled, have the following characteristics:
1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Factory-Assembled Frame Units:
1. Rigidly secure nonmovement joints.
2. Seal joints watertight unless otherwise indicated.
3. Install glazing to comply with requirements in Division 08 Section "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure nonmovement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
   7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Division 08 Section "Glazing."

3.2 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch unless noted otherwise.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch unless noted otherwise.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch unless noted otherwise.
   4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
   1. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
      a. Test Area: One installed assembly, but not less than 30 feet, of glazed aluminum curtain wall.
      b. Perform a minimum of two tests, prior to 70 percent completion.

2. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
   a. *Test Area: One installed assembly, but not less than 30 feet, of glazed aluminum curtain wall.*

C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 08700

BUILDERS HARDWARE

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SECTION 08700

BUILDERS HARDWARE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 GENERAL HARDWARE REQUIREMENTS

A. All materials shall be comparable to those specified and must be approved by the Architect prior to delivery.

B. Submit shop drawings, manufacturer's data, and installation instructions including:
   1. Hardware schedule, organized by "sets," to indicate specifically the product to be furnished for each item required on each door.
   2. Transmittal indicating that the proper hardware information and templates have been submitted to each fabricator of doors and frames for preparation of all doors & frames to receive hardware. (Following approval of shop drawings.)

C. Submit samples of hardware items, showing each required finish from each manufacturer (for acceptance of color and texture only) to the Architect.

D. For fire-rated openings, provide UL tested and listed hardware (A.I.A. Pamphlet 80 and NFPA Standard 80). On panic exit devices, provide UL label indicating "Fire Exit Hardware".

E. Finish and Base Material Designations
   1. Numbers indicate the BHMA Code, or the nearest traditional U. S. commercial finish.
   2. Where base material and quality of finish are not otherwise indicated, provide at least the commercially recognized quality specified in applicable Federal Specifications.

1.3 ACCEPTABLE MANUFACTURERS

A. Part 2 of this section indicates acceptable manufacturers for the primary items of builders hardware. Manufacturer's products which comply with the indicated requirements as determined by the Architect are acceptable for other items.

B. Scheduled Manufacturers' Numbers: An asterisk (*) is shown in the listing of acceptable manufacturers to indicate which manufacturers' product numbers have been used in schedules and elsewhere to establish minimum requirements.

1.4 SUPPLIER

A. A recognized builders hardware supplier who is available at reasonable times during the course of the work for project hardware consultation to the Owner, Architect and Contractor.

1.5 DEPARTURES FROM SCHEDULED DESIGNATIONS

A. Except as otherwise indicated, the use of one manufacturer's numeric designation system in schedules does not imply that another manufacturer's products will not be acceptable, unless they are not acceptable in design, or not equal in size, weight, finish, function, or other quality of significance. However, do not change the selection after Architect's acceptance of hardware supplier's completed hardware schedule.

PART 2 – MATERIALS

2.1 HINGES AND PIVOTS

A. Mfrs. of Butts: Hagar*, McKinney, or Stanley.

B. Provide full mortise type hinges on each door, except as otherwise indicated, and except as otherwise needed for proper support and operation of doors. Provide stainless steel pins, except steel pins with steel hinges; non-removable for exterior and public interior exposure, non-rising for non-security exposure, flat button with matching plug.

C. Function: Plain-bearing, swagged, inner leaf beveled, square corners, except provide ball bearing for doors equipped with closers.

2.2 LOCKS, LATCHES AND BOLTS

A. Manufacturers of Lock/Latch Sets Including Cylinders: Schlage*, Grade 2, AL Series, Neptune design; Corbin/Russwin, CL3500 Series; Sargent 7 Line; Yale 5300LN Series (two year warranty).

B. Strikes: Wrought box strikes, with extended lip for latch bolts. Provide dust-proof strikes for foot bolts.

C. Locks: Equip lock sets with 6 pin tumbler type lock cylinders, in a masterkey system, to be designed by the Owner, delivered to the job in original cartons labeled to required standards.

D. Construction Locks: Either temporary cylinders for construction period, or temporary construction keying which is automatically voided through use of Owner's keys.

E. Provide 3 keys for each lock, plus 4 masterkeys. Master keys shall be delivered to the Architect by Registered Mail, marked on outside of package "DO NOT OPEN", Job Name, Master Keys, Contractor's name.

F. Provide key control system, including envelopes, labels, tags, clips, forms, card index and markers. Supplier is responsible for setting up and indexing keys for end user.

2.3 DOOR CONTROL DEVICES

A. Manufacturers of Overhead Closers: LCN*, Yale, Dor-O-Matic, Jackson, Norton, Rixson, Corbin/Russwin, Sargent, Eaton; (ten year warranty).
   1. Where parallel-arm closers are indicated, provide units one size larger than recommended for standard-arm units.
   2. Provide through bolts for mounting arms to mineral core fire rated doors.

B. Manufacturers of Holders, Stops, Bumpers and Flush Bolts: Baldwin, Glynn-Johnson, Ives*, or Yale.
   1. Door Stops: Provide at all doors as applicable. Wall stops shall be comparable to Ives WS406CCV, WS407CCV or 408-1/2 as required. Floor stops shall be comparable to Ives 436 or 438 as required.
   2. Provide rubber exposed resilient parts.
   3. Comply with manufacturers recommendations for the exposure condition. Reinforce the substrate as recommended.

C. Provide silencers in metal door frames, unless not permitted for fire rating, or unless bumper-type weatherstripping is provided; 3 per single-door frame, 2 per double-door frame.

2.4 DOOR THRESHOLDS, METAL

A. Manufacturers of Extruded Thresholds: National Guard*, Rixson, Wooster, or Zero.

B. Metal: Extruded aluminum.

C. Provide thresholds at sill of each exterior door of sufficient width to completely cover the transition of dissimilar materials and finishes and to bridge and completely cover construction, expansion and control joints. Contractor shall verify existing conditions and coordinate threshold size.

D. All thresholds shall meet the requirements of the Americans With Disabilities Act (ADA).

2.5 DOOR STRIPPING AND SEALS

A. Manufacturers of Stripping and Seals: Accurate, National Guard*, Southern, or Zero.

B. Provide type indicated or, if not indicated, type recommended by mfr. for condition of exposure, with easily replaceable resilient stripping elements.

C. Provide weatherstripping at jambs and head of each exterior door.

2.6 EXIT DEVICES

A. Manufacturers: Von Duprin*, Corbin/Russwin or Sargent.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Mount hardware units at heights indicated in "Recommended Locations for Builders' Hardware" by the Door and Hardware Institute (DHI), except as otherwise specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by the Architect.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in Division 9. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Space fasteners and anchors in accordance with industry standards, and as required for a tight permanent installation.

E. Coordinate installation of hardware with the door, frame and substrate manufacturer, and follow door, frame, or substrate manufacturer's recommendations for installation and installation procedures.

3.2 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in

such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

BUILDERS HARDWARE SCHEDULE

Hardware Set #1
Door 01, 03, 26
Each to Have:

1 Cylinder

Remainder of hardware by the Aluminum Entrance and Storefront Supplier.

Hardware Set #2
Door 02, 05, 20
Each to Have:

Door hardware by the Aluminum Entrance and Storefront Supplier.

Hardware Set #3
Doors 04, 06, 07, 08, 21, 22
Each to Have:

1 ½ Pr. Butts	1191, 4 ½" x 4 ½"	US26D
1 Lockset	AL50PD (Office)	US26D
1 Stop		US26D

Hardware Set #4
Doors 09, 11, 14, 15
Each to Have:

1 ½ Pr. Butts	1191, 4 ½" x 4 ½"	US26D
1 Latchset	AL10S (Passage)	US26D
1 Stop		US26D

Hardware Set #5
Doors 12, 23, 24, 45
Each to Have:

1 ½ Pr. Butts	1191, 4 ½" x 4 ½"	US26D
1 Lockset	AL80PD (Storeroom)	US26D
1 Stop		US26D

Hardware Set #6
Doors 13, 16, 17, 18, 19
Each to Have:

1 ½ Pr. Butts	BB1191, 4 ½" x 4 ½"	US26D
1 Lockset	AL40S (Privacy)	US26D
1 Closer	1460 Series H	Alum

Hardware Set #7
Doors 21, 22, 24
Each to Have:

1 ½ Pr. Butts	BB1191, 4 ½" x 4 ½"	US26D
1 Lockset	AL50PD (Office)	US26D
1 Closer	1460 Series H	US26D

Hardware Set #8
Door 27, 61
Each to Have:

3 Pr. Butts	1191, 4 ½" x 4 ½" NRP	US26D
1 Latchset	AL10S (Passage)	US26D
1 Pair Flush Bolts	FB358	US26D
1 Dust Proof Strike	DP2	US26D
2 Stops		US26D

Hardware Set #9
Door 28, 29
Each to Have:

3 Pr. Butts	BB1191, 4 ½" x 4 ½" NRP	US26D
1 Lockset	AL50PD (Office)	US26D
1 Pr. Flush Bolts	FB358	US26D
1 Dust Proof Strike	DP2	US26D
2 Stops		US26D

Hardware Set # 10
Door 30 (WTP)
Each to have:

1-1/2 Pair Butts	1279, 4-1/2" x 4-1/2"	US26D
1 Exit Device	98L	US26D
1 Wall Stop		US26D

Hardware Set #11
Door 31 (WTP) 32, 34
Each to Have:

3 Pr. Butts	BB 1191, 4-1/2" x 4-1/2" NRP	US26D
1 Exit Device	9827L-17 Lever	US26D
1 Closer	1460 Series H	Alum
1 Pr. Flush Bolts	FB358	US26D
1 Dust Proof Strike	DP2	US26D
1 Overhead Holder/Stop	450H Series	US26D
1 Threshold	896 Vinyl	Alum
1 Set Weatherstripping	160 Vinyl	Alum

Hardware Set #12

Door 30, 31 (Chemical Feed) 33, 35, 36, 40, 41, 42, 43, 60

Each to Have:

1 Pr. Butts	BB1191, 4-1/2" x 4-1/2" NRP	US26D
1 Lockset	AL80PD (Storeroom)	US26D
1 Closer	1460 Series H	Alum
1 Threshold	896 Vinyl	Alum
1 Set Weatherstripping	160 Vinyl	Alum

Hardware Set #13

Doors 37, 38, 44

Each to Have:

1 Cylinder

Hardware Set #14

Door 39

Each to Have:

6 Pr. Butts	BB 1191, 4-1/2" x 4-1/2" NRP	US26D
1 Lockset	AL80PD (Storeroom)	US26D
1 Pr. Flush Bolts	FB358	US26D
1 Dust Proof Strike	DP2	US26D
1 Threshold	896 Vinyl	Alum
1 Set Weatherstripping	160 Vinyl	Alum

Door 50 - Match Existing

END OF SECTION

SECTION 08800

GLAZING

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SECTION 08800

GLAZING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows, Doors, Borrowed Lites and Side Lites.

1.3 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glazing Schedule: Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.

1.5 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated. (Safety Glazing)

C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
   1. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
   2. Sealing System: Dual seal.
   3. Spacer Specifications: Manufacturer's standard spacer material and construction.

D. Wired Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality-Q-6; and of form and mesh pattern specified.

2.2 GLAZING GASKETS

A. Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
   1. Neoprene, ASTM C 864.

2.3 GLAZING SEALANTS

A. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Single-Component Neutral-Curing Silicone Glazing Sealant.
      a. Type and Grade: S (single component) and NS (nonsag).
      b. Class: A
      c. Use Related to Exposure: NT (nontraffic).
      d. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

2.4 GLAZING TAPES

A. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
   1. Type 1, for glazing applications in which tape acts as the primary sealant.
   2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written

instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.7 GLASS UNITS

A. Insulating-Glass Units
   1. Overall Unit Thickness and Thickness of Each Lite: 1" and 6.0 mm.
   2. Interspace Content: Argon
   3. Outdoor Lite: Polished wire glazing (Clear)
      a. Tint Color: As selected from manufacturer's Standard Range.
      b. Low-Maintenance Coating: Pyrolytic coating on first surface.
   4. Indoor Lite: Polished wire glazing (Clear)

B. Tempered Safety Glass
   1. Thickness of Lite: 1/4"
   2. Heat-Treated Float Glass

PART 3 – EXECUTION

3.1 GLAZING

A. General: Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
   1. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
   2. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
   3. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
   4. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
   5. Provide spacers for glass lites where length plus width is larger than 50 inches.
   6. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

B. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Gasket Glazing (Dry): Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
   1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
   2. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer. Install gaskets so they protrude past face of glazing stops.

D. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until

sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.2 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

SECTION 09310

CERAMIC TILE

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SECTION 09310

CERAMIC TILE

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Ceramic mosaic tile.
   2. Glazed wall tile.
   3. Stone thresholds installed as part of tile installations.
   4. Waterproof membrane for thin-set tile installations.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints.

C. Samples:
   1. Each type, composition, color, and finish of tile.
   2. Assembled samples with grouted joints for each type, composition, color, and finish of tile.
   3. Stone thresholds in 6-inch lengths.

1.3 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 – PRODUCTS

2.1 TILE PRODUCTS

A. Available Manufacturers:
   1. American Olean; Div. of Dal-Tile International Corp.
   2. Crossville Ceramics Company, L.P.
   3. Daltile; Div. of Dal-Tile International Inc.
   4. Florida Tile Industries, Inc.
   5. Summitville Tiles, Inc.

B. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

C. Unglazed Ceramic Mosaic (Floor) Tile CT: Factory-mounted flat tile as follows:
   1. Composition: ceramic.
   2. Surface: Slip-resistant, with abrasive admixture.
   3. Module Size: 4 by 4 inch .
   4. Nominal Thickness: 1/4 inch.
   5. Face: Plain with cushion edges.

D. Glazed Ceramic Mosaic (Wall) Tile CT: Factory-mounted flat tile as follows:
   1. Composition: ceramic.
   2. Surface: Slip-resistant, with abrasive admixture.

3. Module Size: 4 by 4 inch .
4. Nominal Thickness: 1/4 inch.
5. Face: Plain with cushion edges.

E. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing where applicable.
1. Base: Coved 6 by 6 inches.
2. External Corners: Bullnose.
3. Internal Corners: Field-butted square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

2.2 ACCESSORY MATERIALS

A. Thresholds: Fabricate to provide transition between adjacent floor finishes. Bevel edges at 1:2 slope, limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.
1. Marble Thresholds: ASTM C 503 with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
a. Description: Uniform, fine- to medium-grained white stone with gray veining.

B. Waterproofing for Thin-Set Tile Installations: Manufacturer's standard product that complies with ANSI A118.10.

2.3 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:
1. LATICRETE International Inc.
2. MAPEI Corporation.
3. Summitville Tiles, Inc.
4. TEC Specialty Products Inc.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
1. Prepackaged dry-mortar mix containing dry additive to which only water must be added.
2. Prepackaged dry-mortar mix combined with liquid-latex additive.
3. For wall applications, provide nonsagging mortar.

C. Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy: ANSI A118.3.

D. Water-Cleanable, Tile-Setting Epoxy Adhesive: ANSI A118.3.

E. Grout: ANSI A118.6 or ANSI A118.7, color as selected by Architect.

F. Grout for Pregrouted Tile Sheets: Same silicone rubber used in factory to pregrout tile sheets.

2.4 MISCELLANEOUS MATERIALS

A. Elastomeric Sealants: Elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials.

C. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

PART 3 – EXECUTION

3.1 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions.

C. Remove protrusions, bumps, and ridges by sanding or grinding.

D. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

E. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.2 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.
   2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

H. Grout tile for chemical-resistant epoxy grouts, comply with ANSI A108.6.

I. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
   1. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

J. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
   1. Tile floors in wet areas.

K. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
   1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

L. Install tile on floors and walls with the following joint widths:
   1. Glazed and unglazed ceramic Tile: 1/16 inch.

M. Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.3 FLOOR TILE INSTALLATION SCHEDULE

A. Interior floor installation on waterproof membrane over concrete; thin-set mortar; TCA F122.
   1. Thin-Set Mortar: Latex-portland cement mortar.
   2. Grout: Polymer-modified sanded grout.

3.4 WALL TILE INSTALLATION SCHEDULE

A. Interior wall installation over masonry or concrete; thin-set mortar; TCA W202.
   1. Thin-Set Mortar: Latex- portland cement mortar.
   2. Grout: Polymer-modified sanded grout.

END OF SECTION

SECTION 09511

ACOUSTICAL PANEL CEILINGS

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SECTION 09511

ACOUSTICAL PANEL CEILINGS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Coordination Drawings: Drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Samples: For each acoustical panel, for each exposed suspension system member, for each exposed molding and trim, and for each color and texture required.

D. Product test reports.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.

B. Fire-Test-Response Characteristics:
   1. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class B materials, when tested per ASTM E 84.
      a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Comply with the following:
   1. ASTM E 580.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of quantity installed, but not fewer than 10.
   2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed, but not fewer than 20.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2.2 GENERAL

A. Acoustical Panel Standard: Comply with ASTM E 1264.

B. Metal Suspension System Standard: Comply with ASTM C 635.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   1. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

E. Seismic struts and seismic clips.

F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.3 ACOUSTICAL PANELS

A. Available Products:
   1. Armstrong World Industries, Inc.; Fine fissured with tegular edge

B. Classification:
   1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.

C. Color: White

D. LR: Not less than .85

E. NRC: Not less than .55

F. CAC: Not less than 35.

G. Edge Detail: Reveal sized to fit flange of exposed suspension system members.

H. Thickness: 5/8 inch.

I. Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEM

A. Available Products:
   1. Armstrong World Industries, Inc.; PeakForm888

B. Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges.
   1. Structural Classification: Intermediate-duty system.
   2. End Condition of Cross Runners: Override (stepped) type.
   3. Cap Material: Steel cold-rolled sheet.
   4. Cap Finish: Painted white

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders.

C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices.

1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
2. Do not attach hangers to steel deck tabs or to steel roof deck.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate with concealed fasteners at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION

SECTION 09651

RESILIENT FLOOR TILE

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SECTION 09651

RESILIENT FLOOR TILE

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Vinyl composition tile (VCT).

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: Full-size units of each color and pattern of resilient floor tile required.

1.3 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 – PRODUCTS

2.1 VINYL COMPOSITION TILE

A. Vinyl Composition Tile (VCT): ASTM F 1066.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Armstrong World Industries, Inc.; **Standard Excelon Imperial Texture.**
      b. Mannington Mills, Inc.; Essentials
      c. Tarkett Inc.; Expressions

B. Color and Pattern: As selected from manufacturer's full range.

C. Class: 2 (through-pattern tile

D. Wearing Surface: Embossed.

E. Thickness: 0.125 inch .

F. Size: 12 by 12 inches.

G. Fire-Test-Response Characteristics:
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 – EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   3. Moisture Testing:
      a. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
   1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
   1. Lay tiles square with room axis

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.
      a. Do not wash surfaces until after time period recommended by manufacturer.

I. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION

SECTION 09653

RESILIENT WALL BASE AND ACCESSORIES

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SECTION 09653

RESILIENT WALL BASE AND ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Resilient base.
   2. Resilient molding accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish not less than 10' or 5 pieces for each type, color, pattern, and size of resilient product installed.

PART 2 – PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. Armstrong World Industries, Inc.
      b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
      c. Johnsonite.
      d. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.
   1. Material Requirement: Type TS (rubber, vulcanized thermoset).
   2. Manufacturing Method: Group I (solid, homogeneous)
   3. Style: Cove (base with toe)

C. Minimum Thickness: 1/8"

D. Height: 4"

E. Lengths: Coils in manufacturer's standard length .

F. Outside Corners: preformed .

G. Inside Corners: preformed .

H. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
      b. Johnsonite.
      c. Roppe Corporation, USA.

B. Description: Carpet edge for glue-down applications; Joiner for tile and carpet Transition strips.

C. Material: Rubber.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION

SECTION 09680

CARPET

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SECTION 09680

CARPET

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes carpet, installation, and accessories.

1.2 SUBMITTALS

A. Product data for each type of carpet material and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics.

B. Samples for verification purposes in manufacturer's standard size, showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Submit the following:

1. 12-inch-square samples of each type of carpet material required.
2. 12-inch-long samples of each type exposed edge stripping and accessory item.

1.3 QUALITY ASSURANCE

A. Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting organization.

1. Test Method: DOC FF 1-70.
2. Rating: Pass.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.

B. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 deg F (20 deg C) at least three days prior to and during installation in area where materials are stored.

1.3 PROJECT CONDITIONS

A. Substrate Conditions: No condensation within 48 hours on underside of 4-foot by 4-foot polyethylene sheet, fully taped at perimeter to substrate.

PART 2 – PRODUCTS

2.1 ACCESSORIES

A. Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber; minimum 2-inch-wide anchorage flange; manufacturer's standard colors.

B. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

C. Carpet Adhesive: Water resistant and nonstaining as recommended by carpet manufacturer to comply with flammability requirements for installed carpet.

PART 3 – EXECUTION

3.1 PREPARATION

A. Remove and properly dispose of existing carpet. Clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet; apply sealer, if required, to prevent dusting.

3.2 INSTALLATION

A. Comply with manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame, in direction of traffic through doorway. Do not bridge building expansion joints with continuous carpet.

B. Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.

C. Provide cutouts where required, and bind cut edges where not concealed by protective edge guards or overlapping flanges.

D. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

E. Install carpet by trimming edges, butting cuts with seaming cement, and taping and/or sewing seams to provide sufficient strength for stretching and continued stresses during life of carpet.

F. Stretch carpet to provide smooth, ripple-free, taut, trim edges; secure to stripping and conceal behind edge of stripping. Use power stretcher where carpet length is greater than 20 feet.

G. Fit sections of carpet prior to application of adhesive. Trim edges and butt cuts with seaming cement.

H. Apply adhesive uniformly to substrate in accordance with manufacturer's instructions. Butt edges tight to form seams without gaps. Roll entire area lightly to eliminate air pockets and ensure uniform bond.

3.3 CLEANING

A. Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.

B. Remove and dispose of debris and unusable scraps. Vacuum with commercial machine with face-beater element. Remove soil. Replace carpet where soil cannot be removed. Remove protruding face yarn.

C. Vacuum carpet.

3.2 PROTECTION

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure carpet is not damaged or deteriorated at time of Substantial Completion.

3.3 CARPET ALLOWANCE

E. Include the cost of $25.00 per square yard of carpet delivered to the site. After selection of the actual carpet to be used, a Change Order will be issued to add to or deduct from the Contract amount any difference between the actual cost charged and the allowance.

END OF SECTION

SECTION 09850

CORROSION-RESISTANT TANK LINING (CRTL)

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SECTION 09850

CORROSION-RESISTANT TANK LINING (CRTL)

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Corrosion-resistant tank lining.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 3 - Concrete.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Applicator to be licensed or approved, in writing, by manufacturer.
   2. Applicator to have successfully completed minimum of three projects in last 5 years with similar scope.
   3. Provide references for minimum of three projects in last 5 years including type of installation, square footage of material installed and name and telephone number of client contact.

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 and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Complete schedule of proposed coatings and installation locations.
      b. Acknowledgment that products submitted meet requirements of standards referenced.
      c. Manufacturer's installation instructions.
      d. Complete physical and chemical characteristics.
      e. Manufacturer's standard published chemical-resistance information.
      f. Manufacturer's recommendations for adhesives, primer, and miscellaneous materials used.
   3. Applicator's qualifications and references.
   4. Warranty.

B. Samples:
   1. 6 x 6 IN samples of manufacturer's full range of standard colors for Engineer's color selection.

1.5 WARRANTY

A. Provide written 3-year warranty.

B. Warrant Coating Against:
   1. Delamination from substrate.

2. Degradation of finish.
3. Cracking and spalling.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Chemical-resistant tank lining:
      a. Tnemec.
      b. Carboline.
      c. Polyspec.
      d. Or approved equal.

B. Submit requests for substitution in accordance with Specification Section 01640 - Product Substitutions.

2.2 MATERIALS

A. Chemical-Resistant Tank Lining:
   1. Solids by volume: Minimum 89 percent mixed (theoretical).
   2. Finish: Gloss, Semi-gloss, or satin.
   3. Color: Manufacturer's standard.
   4. Type: The following types of coatings are allowable and should be recommended and matched by the coating supplier to the specific chemical with which they will come into contact:
      a. Sprayable, high solids, high build aromatic elastomeric polyurethane.
      b. Sprayable, Novolac Vinyl Ester, with or without glass flake reinforcement.
   5. Primer: High solids amine epoxy.

B. Chemical Resistance: (No failure at temperatures below 120°F and above -10°F.
   1. Hydrofluorosilic Acid (Fluoride): 23%.
   2. Dalpac 2020 (Coagulant): 100%.
   3. Sodium Hydroxide (Caustic): 25%.
   4. Sodium Permanganate: 20%.

C. Coatings used in exterior application shall be UV resistant.

D. Sealant for Joints in Concrete Tankage: As recommended by lining manufacturer.

PART 3 – EXECUTION

3.1 APPLICATION

A. Verify suitability of substrate to accept installation.
   1. Prepare substrate in accordance with manufacturer's written instructions.
   2. Allow concrete to cure for minimum of 28 days at 70oF or above.
   3. Fill and seal porous concrete surfaces as recommended by manufacturer.
   4. Remove spent blasting material and dust by vacuuming.

B. Application of material indicates acceptance of the substrate.

C. Apply primer and finish coats in accordance with manufacturer's recommendations.
   1. Apply primer in single coat to thickness recommended by manufacturer.
   2. Apply finish coat(s) to thickness recommended by manufacturer.

D. Maintain minimum temperatures before, during, and after coating application to assure proper curing.

E. Test wet mil thickness as recommended by manufacturer to provide uniform accurate coverages.

F. Apply CRTL to all concrete surfaces at containment areas that could come into direct contact with chemicals as indicated on the Drawings.

3.2 FIELD QUALITY CONTROL

A. Provide services of manufacturer's authorized representative during coating application, substrate preparation and after all coating work is completed.
   1. Certify that coating has been properly applied to required mil thickness.

B. Repair all defective coating in accordance with manufacturer's printed recommendations.

END OF SECTION

SECTION 09900

PAINTING

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SECTION 09900

PAINTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. This specification only applies to painting within conditioned (cooled) spaces. Section 09905 applies to all other spaces, including, but not limited to: Pipe Galleries, Filter Operations Floor, Chemical Feed Building, Flocculators Intermediate Booster Pump Station, Energy Recovery Building, and all other non-conditioned space.

B. The extent of painting is shown on the drawings and schedules, and as herein specified. The terms "paint" or "painting" are used in this section as a general reference to sealers, primers, stains, oil, alkyd, latex, polyurethane, epoxy and enamel type paints and the application of these materials.

C. Work Included: The painting of all exposed surfaces. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified in other Sections.

D. Work not included: Shop priming of ferrous metal items and fabricated components are included under their respective trades, unless otherwise indicated. Pre-finished items are not included. Painting is not required on surfaces of concealed areas except for piping and equipment within the concealed space, unless otherwise indicated. Finished metals will not be painted, unless otherwise indicated. Do not paint any moving parts of operating units, or over any equipment identification, performance rating, name or nomenclature plates, or labels required by code.

1.3 SUBMITTALS

A. Complete materials list of all items proposed to be furnished and installed under this section including:

B. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.

C. For information only, submit two copies of manufacturer's specifications, including paint analysis and application instructions for each material. Indicate by transmittal that a copy of each manufacturer's instructions has been distributed to the applicator.

D. Revise, correct and resubmit if required by the Architect.

1.4 SAMPLES

A. Submit samples for Architects review of color and texture only.

1.5 DELIVERY AND STORAGE

A. Deliver all materials to the job site in original new and unopened containers bearing the manufacturer's name, trade name, label analysis and application instructions. Provide proper storage to prevent damage to and deterioration of materials.

1 1.6 PROTECTION

2 A. Protect work of other trades. Correct any painting related damages by cleaning, repairing or
3 replacing, and refinished at no cost to the Owner, as directed by the Architect.

4 1.7 WEATHER CONDITIONS

5 A. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85% or
6 to damp or wet surfaces; unless otherwise permitted by the manufacturer's printed
7 instructions as approved by the Architect. Applications may be continued during inclement
8 weather within the temperature limits specified by the paint manufacturer during
9 application and drying periods.

10 PART 2 – PART 2 - PRODUCTS

11 2.1 MANUFACTURERS

12 A. Manufacturers offering products to comply with the requirements include, but are not
13 limited to: PPG Industries, Inc. (Basis of Design); The Sherwin-Williams Company; Pratt &
14 Lambert.

15 2.2 DURABILITY

16 A. Provide paints of durable and washable quality. Do not use paint materials which will not
17 withstand normal washing as required to remove pencil marks, ink, ordinary soil, and similar
18 material without showing discoloration, loss of gloss, staining, or other damage.

19 2.3 ACCESSORY MATERIAL

20 A. This work shall include all required ladders, scaffolding, drop cloths, maskings, scrapers,
21 tools, dusters, cleaning solvents, and waste as required to perform the work and achieve the
22 results herein specified.

23 B. For application of the approved paint, use only such equipment as is recommended for
24 application of the particular paint by the manufacturer, and as approved by the Architect.

25 2.4 COORDINATION

26 A. Notify the Architect in writing of anticipated problems using specified coatings with
27 substrates primed by others. Provide finish coats which are compatible with prime paints
28 used. Provide barrier coats over incompatible primers, where required.

29 PART 3 – EXECUTION

30 A. Only skilled mechanics shall be employed. Application may be by brush, roller or spray,
31 upon approval from the Architect.

32 B. The Contractor shall protect his work at all times, and shall also protect all adjacent work
33 and materials by suitable covering or other method during progress of his work. Upon
34 completion of the work all paint and varnish spots shall be removed from floors, glass and
35 other surfaces. All rubbish and accumulated materials resulting from this work shall be
36 removed from premises.

37 3.2 SURFACE CONDITIONS

38 A. Prior to installation of the work of this Section, carefully inspect the installed work of all
39 other trades and verify that all such work is complete to the point where this installation
40 may properly commence. Verify that painting may be completed in strict accordance with
41 the original design and with the manufacturers' recommendations as approved by the

Architect. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.3 SURFACE PREPARATION

A. Perform preparation and cleaning procedures in strict accordance with coating manufacturer's instructions for each substrate condition.

B. Remove hardware and accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finish-painted, or provide surface-applied protection. Reinstall removed items.

C. Prior to the painting of any surface that is not new work, the Architect shall examine the cleaned and prepared substrate. If, in the opinion of the Architect, the surface requires additional preparation, it shall be reworked until it meets the Architect's approval.

3.4 MATERIAL PREPARATION

A. Mix, prepare, and store painting and finishing materials in accordance with manufacturer's directions.

3.5 APPLICATION

A. Apply painting, staining and finishing materials in accordance with the manufacturer's directions. Use applicators and techniques best suited for the materials and surfaces to which applied.

B. Apply additional coats when undercoats, stains or other conditions show through final paint coat, or coating thickness does not equal manufacturer's recommendations of specified thickness, or until paint film is of uniform finish, color and appearance.

C. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.

D. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

E. Finish exterior doors on tops, bottoms and edges same as exterior faces, unless otherwise indicated.

F. Sand lightly between succeeding enamel or varnish coats.

G. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise specified.

H. Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total dry film thickness or not less than 4.0 mils for the entire coating system of prime and finish coats for 3 coat work.

I. Provide a total dry film thickness of not less than 2.5 mils for the entire coating system of prime and finish coat for 2 coat work.

J. Prepare cementitious surfaces and concrete block to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

K. Determine the alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

3.6 COMPLETED WORK

A. Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.7 PAINTING SCHEDULE

A. Exterior Painting

1. Metal

One (1) Coat:	PPG 6-208 Red Inhibitive Metal Primer
Two (2) Coats:	PPG 54 Line Quick-Dry Enamel.

2. Fiber Cement Trim

Two (2) Coats:	PPG 78 Line Sun-Proof Semi-Gloss Acrylic Latex House and Trim Paint.

B. Interior Painting

1. Gypsum Drywall (Eggshell Finish)

One (1) Coat:	PPG 17-10 Quick-Drying Interior Latex Primer-Sealer.
Two (2) Coats:	PPG 89 Line Manor Hall Eggshell Latex Wall and Trim Enamel.

2. Gypsum Drywall (Semi-Gloss Finish)

One (1) Coat:	PPG 17-10 Quick-Drying Interior Latex Primer-Sealer.
Two (2) Coats:	PPG 88-110 Satinhide Interior Enamel Wall and Trim Lo-Lustre Semi-Gloss Latex.

3. Metal

One (1) Coat:	PPG 6-208 Red Inhibitive Metal Primer; P&L Effecto Rust-Inhibiting Primer
Two (2) Coats:	PPG 54 Line Quick-Dry Enamel; P&L Effecto Enamel.

4. Masonry Units

One (1) Coat:	PPG 6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.
Two (2) Coats:	PPG 88-110 Satinhide Interior Enamel Wall and Trim Lo-Lustre Semi-Gloss Latex.

5. Wood (Painted)

One (1) Coat:	Glidden UH 400 Ultra-Hide Alkyd Interior Enamel Undercoater; PPG 17-255 Quick-Drying Enamel Undercoater; P&L S/D 1011 Suprime "11" Interior Alkyd Wood Primer.
Two (2) Coats:	Glidden UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel; PPG 27 Line Wallhide Low Odor Interior Enamel Wall and Trim Semi-Gloss Oil; P&L S/D 5700 Cellu-Tone Alkyd Satin Enamel.

END OF SECTION

SECTION 09905

PAINTING AND PROTECTIVE COATINGS

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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.
   3. This specification only applies to painting within non-conditioned spaces. Painting in the conditioned spaces (cooled) in the plant building is covered by Section 09900.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete*.

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. Z53.1, Safety Color Code for Marking Physical Hazards.
   2. American Society for Testing and Materials (ASTM):
      a. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
      c. D4259, Standard Practice for Abrading Concrete.
      d. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
      e. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
      f. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
      g. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. National Bureau of Standards (NBS):
      a. Certified Coating Thickness Calibration Standards.
   4. 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-6, Commercial Blast Cleaning.
      f. SP-10, Near-White Blast Cleaning.
      g. SP-13, Surface Preparation of Concrete.

B. Qualifications:
   1. Applicator shall have minimum of 5 years experience in application of similar products on similar project. Provide references for minimum of three different projects completed in last 5 years. Include name and address of project, size of project in value (painting) and contact person.

C. Miscellaneous:
   1. Furnish paint through one manufacturer when possible.

D. Deviation from specified mil thickness or product type is not allowed without written authorization of Engineer.

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.

C. Exposed Exterior Surface: Surface which is exposed to the weather but not necessarily exposed to view as well as surface exposed to view.

D. Finished Room or Space: One that has finish called for on Room Finish Schedule or is indicated, on Drawings, to be painted.

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. Shop Drawings:
   1. See Section 01340 – *Shop Drawings, Product Data & Samples; Operation & Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment 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. Manufacturer's factory-applied finish information. Refer to paragraph 3.2-B.

D. Samples:
   1. Manufacturer's full line of standard colors for Engineer's color selection.

E. Miscellaneous Submittals:
   1. Painter'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, the following manufacturers are acceptable:
   1. Tnemec.
   2. Ameron International.
   3. Valspar Corp.
   4. Carboline.
   5. Porter Paints.
   6. Sherwin Williams.
   7. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 – *Product Substitutions*.

2.2 MATERIALS

A. For unspecified materials such as thinner, provide manufacturer's recommended products.

B. 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.

C. Products specified are manufactured by Tnemec unless otherwise specifically noted to be by other manufacturer.

D. Coating Systems:
   1. System #1 - Epoxy-Polyamide Primer with Epoxy-Polyamide or Aliphatic Acrylic Polyurethane Top Coats.
      P1=N69-1211 Poxyprime (Polyamidoamine Epoxy) VOC=2.29
      1 coat, 4 mils
      F1= Series 66 Hi-Build Epoxoline (Epoxy-Polyamide) VOC=3.04
      1 coat, 3 mils
      *F2 = Series 66 Hi-Build Epoxoline (Epoxy-Polyamide)
      1 coat, 3 mils
      *F2E Series 73 Endura-Shield (Semi Gloss) VOC=3.16
      (Aliphatic Acrylic Polyurethane)
      *Replace F2 with F2E for exterior environment.
   2. System #2 - NOT USED.
   3. System #3 - Epoxy-Polyamide Primer with Epoxy-Polyamide or Aliphatic Acrylic Polyurethane Top Coats.
      P1=Series 66 Hi-Build Epoxoline VOC=3.42
      (Epoxy-Polyamide)
      1 coat, 2 mils
      *F1=Series 66 Hi-Build Epoxoline (Epoxy-Polyamide)
      1 coat, 2 mils
      *F1E=Series 73 Endura-Shield (Semi Gloss) VOC=3.5
      (Aliphatic Acrylic Polyurethane)
      1 coat, 2.5 mils
      *Replace F1 with F1E for exterior environment
   4. System #4 - Zinc-rich Urethane Primer with Epoxy-Polyamide or Aliphatic Acrylic Polyurethane Top Coats.
      P1=90-97 Tneme-Zinc (Zinc-Rich Urethane) VOC=3.10
      1 coat, 2.5 mils
      *F1=Series 66 Hi-Build Epoxoline (Epoxy-Polyamide) VOC=3.42
      1 coat, 3 mils
      *F1E=Series 73 Endura-Shield (Aliphatic Acrylic Polyurethane) VOC=3.50
      1 coat, 2.5 mils

*Replace F1 with F1E for exterior environment

5. System #5 - Moisture-Cured Urethane Primer with Epoxy-Polyamide or Aliphatic Acrylic Polyurethane Top Coats.
   P1=530 Omnithane (Moisture-Cured Urethane) VOC=3.42
   1 coat, 2.5 mils
   *F1=Series 66 Hi-Build Epoxoline (Epoxy-Polyamide) VOC=3.42
   1 coat, 4 mils
   *F1E=Series 73 Endura-Shield (Aliphatic Acrylic Polyurethane) VOC=3.50
   1 coat, 2.5 mils
6. System #6 - NOT USED.
7. System #7 - Epoxy-Polyamide Primer with Epoxy-Polyamide or Aliphatic Acrylic Polyurethanel Top Coats.
   P1=Series 65 Poxiprime II (Epoxy-Polyamidaomine) VOC=3.46
   1 coat, 4 mils
   *F1=Series 66 Hi-Build Epoxoline (Epoxy-Polyamide) VOC=3.42
   1 coat, 5 mils
   *F1E=Series 73 Endura-Shield (Aliphatic Acrylic Polyurethane) VOC=3.50
   *Replace F1 with F1E for exterior environment.
8. System #8 - NOT USED.
9. System #9 - NOT USED.
10. System #10 - NOT USED.
11. System #11 - Zinc-Rich Urethane Primer.
    P1=90-97 Tneme-zinc (Zinc-Rich Urethane) VOC=3.10
    1 coat, 3.5 mils
12. System #12 - Emulsified Acrylic Primer and Top Coat.
    P1=Series 6 Tneme-Cryl (Emulsified Acrylic) VOC=1.89
    1 coat, 2.5 mils
    F1=Series 6 Tneme-Cryl (Emulsified Acrylic)
    1 coat, 2.5 mils
13. System #13 - NOT USED.
14. System #14 - NOT USED.
15. System #15 - Epoxy-Polyamide Primer with Epoxy-Polyamide Top Coat.
    P1=Series 66 Hi-Build Epoxoline (Epoxy-Polyamide) VOC=3.42
    1 coat, 4 mils
    F1=Series 66 Hi-Build Epoxoline (Epoxy-Polyamide)
    1 coat, 4 mils
16. System #15A - Acrylic Copolymer Sealant.
    F1=Series 624 Phylon (Acrylic Copolymer) VOC=2.96
    1 coat, 4 150 to 175 SF/GAL
    System #16 - NOT USED.
17. System #17 - NOT USED.
18. System #18 - NOT USED.
19. System #19 - Epoxy-Polyamide Coating.
    P1=Series 66 Hi-Build Epoxoline(Epoxy-Polyamide) VOC=3.42
    1 coat, 5 mils
20. System #20 - NOT USED.
21. System #21 - NOT USED.
22. System #22 - NOT USED.
23. System #23 - Epoxy-Polyamide Primer with Epoxy-Polyamide Top Coat.
    P1=Series 20-1255 Pota-Pox (Epoxy-Polyamide PW System) VOC=3.42
    1 coat, 4 mils
    F1=Series 20-2000 Pota-Pox (Epoxy-Polyamide PW System) VOC=3.42
    1 coat, 4 mils.
24. System #24 - NOT USED.
25. System #25 - NOT USED.
26. System #26 - NOT USED.
27. System #27 - Vinyl-Acrylic Latex Block Filler with Waterborne Acrylic Epoxy Top Coats.
    P1=54-660 Latex Masonry Filler (Vinyl-Acrylic Latex) VOC=1.34
    1 coat, 75 to 100 GAL/SF/coat
    F1=Series 113 H.B. Tneme-Tufcoat (Waterborne Acrylic Epoxy) VOC=2.46

1 coat, 2.5 mils
F2=Series 113 H.B. Tneme-Tufcoat (Waterborne Acrylic Epoxy)
1 coat, 2.5 mils.

28. System #28 - NOT USED.
29. System #29 - Rust Inhibitive Metal Primer with Acrylic-Enamel Top Coats.
    P1=Devoe 13101 Mirrolac Rust Penetrating Metal Primer.
    1 coat, 1.5 mils.
    F1=Devoe 17XX Wonder-Shield.
    1 coat, 2.6 mils.
    F2=Devoe 17XX Wonder-Shield.
    1 coat, 2.6 mils.
30. System 29A - Rust Inhibitive Metal Primer with Alkyd Enamel Intermediate Coat and Acrylic-Latex Top Coat.
    P1=Devoe 13101 Mirrolac Rust Penetrating Metal Primer.
    1 coat, 1.5 mils.
    F1=Devoe 39xx Wonder-Tones Semi-gloss Latex Enamel
    1 coat, 1.5 mils.
    F2=Devoe 39xx Wonder-Tones Semi-gloss Latex Enamel
    1 coat, 1.5 mils.
31. System #30 - NOT USED.
32. System #31 - NOT USED.
33. System #32 - NOT USED
34. System # 33 - Mat Reinforced Mortar Lining System (Fiberglass Reinforcement).
    P1 - Series 2395C Primer applied at 6.0 - 10.0 dry mils.
    P2 - Series 2395C Mortar/Surry Basecoat applied at 60.0 - 80.0, embed 3/4 oz. chopped fiberglass strand mat and then apply a saturant coat of Series 2355C liquids at 6.0 - 12.0 dry mils.
    F1 - Series 282 Tneme-Glaze applied at 8.0 - 10.0 dry mils.
    F2 - Series 282 Tneme-Glaze applied at 8.0 - 10.0 dry mils.
35. System #34 - Cycloaliphatic Amiac Epoxy.
    P1 - Series 215 Surfacing Epoxy applied at 0.8 mm to 3.2 mm dry mils.
    F1 - Series 61 - Tneme-Liner applied at 8.0 to 12.0 dry mils.
    F2 - Series 61 - Tneme-Liner applied at 8.0 to 12.0 dry mils.

PART 3 – EXECUTION

3.1 ITEMS TO BE PAINTED

A. Exposed Exterior Surfaces including:
   1. Plain, insulated, or wrapped piping, valves, fittings, hydrants, and appurtenances; except when covered by lagging.
   2. Conduit and appurtenances.
   3. Ferrous metals.
   4. Exposed wood.
   5. Galvanized metal surfaces.

B. Interior Finished Areas:
   1. Concrete walls as noted on the Drawings.
   2. Concrete masonry walls.
   3. Concrete ceilings as noted on the Drawings.
   4. Plain, insulated, or wrapped piping; valves; fittings; and appurtenances.
   5. Conduit and appurtenances.
   6. Ferrous metals.
   7. Galvanized metal surfaces.

C. New and Existing Equipment:
   1. Paint new and existing 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. Any items to be painted that are in contact with process water shall be coated with NSF-61 coating.

B. Items with Approved Factory Finish:
   1. Do not field paint items with Approved Factory Finishes, as defined; including the following:
      a. Prefinished sheet metal.
      b. Prefinished metal roof and wall panels.
      c. Finished electrical equipment.

C. Surfaces Hidden from View including:
   1. Piping.
   2. Conduit.
   3. Insulation.
   4. Manufacturer's standard coatings, if any, may remain.

D. Other Items:
   1. Stainless steel surfaces except:
      a. Piping.
      b. Banding as required to identify piping.
   2. Aluminum surfaces except:
      a. Where specifically shown in the Contract Documents.
      b. Where imbedded in concrete.
      c. Where in contact with dissimilar metals.
   3. Interior of pipe, ductwork, and conduits.
   4. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
   5. Code labels and equipment identification and rating plates.
   6. Exterior concrete or precast concrete surfaces.

3.3 PAINTING SCHEDULE

	Painting System Number
A. Concrete:	
1. Interior cast-in-place and interior precast surfaces (other than prefinished panels) in areas indicated on the Drawings and identified in the Finish Schedule to be painted, including equipment bases, pads, walls (that are not below grade or part of a liquid containing structure), beams, columns, pedestals, pilasters, etc.	15
2. Interior cast-in-place and interior precast walls (other than prefinished panels) below grade.	15A
3. Concrete which may regularly come in contact with process waters.	23
B. *Concrete Masonry Units:*	
1. Interior.	27
C. Structural Steel:	7
D. *Ferrous Metals:* May include steel handrails and guardrails, steel stairs, exterior of steel tankage, tank or equipment bridges, pumps, and similar items.	

		Painting System Number
	1. Exterior Exposure:	29
	2. Interior Exposure:	29A
E.	Galvanized Metals:	
	1. Field cut edge where top coat is required.	
	a. This paint coating to be applied after galvanizing has been repaired in accordance with ASTM A780.	4
	2. Assembled galvanized steel items.	3
	3. Field touch-up of galvanized surfaces not requiring a finish top coat.	
	a. This paint coating to be applied after galvanizing has been repaired in accordance with ASTM A780.	11
F.	Doors, door frames, and window frames:	
	1. Steel doors and frames primed in the factory in conformance with ANSI A224.1.	5
G.	Plastic Surfaces:	
	1. PVC, FRP, and CPVC surfaces.	3
	2. PVC, FRP, and CPVC in contact with process water (in areas indicated on the Drawings).	23
H.	Electrical Conduit:	
	1. Galvanized.	3
	2. PVC coated.	3
I.	Pipe, Valves, and Fittings: (Not in contact with potable water)	
	1. Steel and cast-iron.	1
	2. Stainless.	1
	3. Brass and bronze.	3
	4. PVC, FRP, and CPVC.	3
J.	Pipe and Duct Insulation.	12
K.	Aluminum buried in concrete and between dissimilar metals which are not below liquid level.	19
L.	All ferrous metal piping and surfaces submerged in process water or subject to splash, spillage, vapor, condensation or other chronic process water exposure.	23
M.	Interior of Filter Bays and adsorption clarifiers.	23
N.	Floor of Fluoride Room to terminate 8 inches from FFE on walls and concrete protusions.	33
O.	Floor and walls of secondary containment and bulk storage containment.	34

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.
   3. Protect process water from spray.

C. Prepare and Paint Before Assembly: Where component is subject to corrosive environment, prepare and paint, before assembly, all surfaces which may be subject to corrosive 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. Surfaces subject to corrosive environment:
      a. Near-white blast clean in accordance with SSPC SP-10.
   3. Interior and exterior surfaces not subject to corrosive environment (including structural steel surfaces):
      a. Commercial blast clean in accordance with SSPC SP-6.

E. Hollow Metal:
   1. Solvent clean in accordance with SSPC SP-1.

F. Concrete:
   1. Cure for minimum of 28 days.
   2. Verify that concrete surfaces have been cleaned and that voids have been patched in accordance with Section 03002.
      a. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
   3. 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 surface with clean water as required to bring pH within acceptable limits.
      b. Retest pH until acceptable results are obtained.
   4. 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 range is obtained.
   5. Mechanically abrade concrete surfaces in accordance with ASTM D4259 as recommended by coating manufacturer.

3.5 APPLICATION

A. General:
   1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
   2. Temperature and weather conditions:
      a. Do not paint surfaces when surface temperature is below 50°F unless 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 accepted by NACE certified coatings inspector, apply structural steel, miscellaneous steel, and steel joist prime coat in the factory.

a. Finish coats shall be applied in the field.

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.
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. Back roll concrete 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. Ensure new coatings applied over existing coatings are compatible.
      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. Apply zinc-rich primers while under continuous agitation.
   5. Ensure abrasive blasting operation does not result in embedment of abrasive particles in paint film.
   6. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
   7. Fill all pores of concrete block completely using block filler specified.
   8. Touch up damaged primer coats prior to finish coats.
   9. 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.
   3. Prepare damaged area in accordance with Article 3.4.

3.6 COLOR CODING

A. Color and band piping in accordance with Article 3.9 of this Section.
   1. Band piping using maximum of three different colors at 20 FT maximum centers.
   2. Place bands:
      a. Along continuous lines.

b. At changes in direction.
c. At changes of elevation.
d. On both sides of an obstruction (i.e., wall, ceiling that painted item passes through.

3. Band width for individual colors (pipe diameter measured to outside of insulation):
   a. Piping up to 8 IN DIA: 2 IN minimum.
   b. Piping greater than 8 IN up to 24 IN DIA: 4 IN minimum.

3.7 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.

B. Manufacturer's field representative shall be on site to observe application of coating specified in System No.2, and to inspect substrate for these systems prior to coating application.

C. Where a wall or ceiling is disturbed and patched, repaint entire wall or ceiling.

D. Measure wet paint with wet film thickness gages.

E. 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.

F. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.

G. Measure substrate humidity with humidity gage specifically designed for such.

H. Provide wet paint signs.

3.8 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.

3.9 COLOR SCHEDULE

A. Piping and Pipe Banding Color Schedule:

Legend	Color
Backwash	Blue (match existing)
Backwash Drain	Brown (match existing)
Compressed Air	Dark Green
Powered Activated Carbon	Black
Chlorine Solution	Yellow
Drain	Light Gray
Potable Water	Blue (match existing)
Filter Effluent	Blue (match existing)
Filter to Waste	Brown (match existing)
Fluoride Solution	Light Blue w/ Red Banding
Finished Water	Blue (match existing)
Low Pressure Air	Light Gray
Polymer	White
Rain Leader	Light Gray
Sample	Do not paint
Sedimentation Effluent	Aqua (match existing)
Sump Discharge	Gray

Storm Drain	Gray
Seal Water	Blue
Temporary Piping	Do not paint
Taylor's Valley Water	Do not paint

END OF SECTION

SECTION 10172

HIGH DENSITY POLYMER TOILET COMPARTMENTS

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SECTION 10172

HIGH DENSITY POLYMER TOILET COMPARTMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes: High density polymer plastic toilet compartments and urinal screens, including required fittings, hardware, and accessories.

B. Related sections:
   1. Section 10800 - *Toilet Accessories: Accessories Mounted on Toilet Compartments.*

1.3 REFERENCES

A. Americans with Disabilities (ADA) Standards for Accessible Design.

B. ANSI A117.1 - American National Standard for Buildings and Facilities - Providing Accessibility and Usability for Physically Handicapped People.

C. ASTM A167 - Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. UFAS - Uniform Federal Accessibility Standards.

1.4 SUBMITTALS

A. Provide in accordance with Section 01300 - Submittal Procedures:
   1. Product data for compartments, panels, finishes, hardware, and accessories.
   2. Shop drawings showing partition plans, elevations, dimensions, door swings, details for supports, and method of anchorage.
   3. Samples of manufacturer's finishes [for selection by Architect].
   4. Installation instructions.
   5. Maintenance instructions.
   6. Copy of warranty required by Paragraph 1.5 for review by Architect.

1.5 QUALITY ASSURANCE

A. Products and installation shall comply with ADA Standards, ANSI A117.1, and UFAS.

1.6 WARRANTY

A. Provide 15 years warranty to cover panels, doors, and pilasters against breakage, delamination, and corrosion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering access flooring that may be incorporated in the Work include, but are not limited to, the following:
   1. General Partitions Mfg. Corp.

2. Accurate Partitions Corp.
3. Global Steel Products Corp.
4. Or approved equal.

2.2 TYPES

A. Toilet compartments: Panels supported by pilasters anchored to floor and braced overhead with headrail.

B. Urinal screens: Screens hung from wall with continuous aluminum channel.

2.3 PANELS

A. Material: Molded under pressure from high density polymer resin with uniform color throughout.
   1. Resistant to delamination, water, steam, corrosion, soaps, detergents, and mildew. Does not absorb odors.
   2. Self-lubricating surface that is graffiti resistant to markings from pen, pencil, marker, and paint.
   3. Edges: Machine radius eliminating sharp edges.
   4. Surface texture: Orange peel.

B. Heat sincs: Attach 1/8 inch aluminum strips with screws to bottom edges of panels and doors to protect panel from being ignited by vandals.

C. Minimum nominal thickness:
   1. Panels: 1 inch.
   2. Doors: 1 inch.
   3. Pilasters: 1 inch.

D. Sizes: As indicated on Drawings.
   1. Toilet compartment panel: Width to suit compartment depth shown on Drawings by 55 inches high.
   2. Inswinging door: 24 inches wide by 55 inches high.
   3. Pilaster: Width to suit compartment size by 82 inches high.

2.4 FITTINGS

A. Headrail: Extruded aluminum channel with anti-grip shape, designed to fit over top of pilasters, 1-7/8 by 1-1/32 inches.

2.5 HARDWARE

A. Hinges: 8 inches high extruded aluminum warp around pivot hinges with nylon cams and adjustable for door closing position.

B. Combination coat hook and rubber bumper: Cast alloy, chrome plated.

C. Latch: Surface mounted, extruded aluminum slide latch that does not require twisting or turning of wrist to operate.

D. Combination latch keeper and door stop with rubber bumper: Extruded aluminum.

E. Door pull: Cast alloy, chrome plated, straight loop design.

2.6 FACTORY FINISHING

A. Color: Single color as selected by Architect from manufacturer's standard range.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify correct spacing of plumbing fixtures.

3.2 INSTALLATION

A. Install partitions secure, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1 inch uniform space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices recommended by manufacturer.

D. Attach panels and pilasters to brackets with sheet metal screws.

E. Brace pilasters with overhead rail. Locate headrail joints at pilaster center lines.

F. Anchor pilaster to floor with heavy duty galvanized steel angle plate, sheet metal, screws, and anchors. Conceal floor fastenings with pilaster shoes.

G. Door installation: Hang doors from pilasters. Provide two hinges for 24 inches wide doors and three hinges of doors greater than 24 inches wide. Equip each door with door latch, door strike and keeper, and coat hook and bumper. Install door pull on outswinging doors.

3.3 ERECTION TOLERANCES

A. Maximum variation from true position: 1/4 inch.

B. Maximum variation from plumb: 1/8 inch.

3.4 ADJUSTING

A. Replace significantly damaged, deeply scratched, or broken panels.

B. Adjust hinges to locate inswinging doors in partial open position and outswinging doors in closed position when unlatched.

C. Adjust and align hardware to uniform clearance at vertical edge of doors.

3.5 CLEANING

A. Clean surfaces with liquid spray furniture or counter top polish. Do not use abrasives.

END OF SECTION

SECTION 10200

LOUVERS AND VENTS

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SECTION 10200

LOUVERS AND VENTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes fixed, extruded-aluminum louvers.

B. See Division 8 Section "Steel Doors and Frames" for louvers in hollow-metal doors and frames.

C. See Division 15 Sections for louvers that are a part of mechanical equipment.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and wind loads based on a uniform pressure of 20 lbf/sq. ft. (957 Pa), acting inward or outward, without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

B. Thermal Movements: Provide louvers that allow for thermal movements resulting from a temperature change (range) of 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces, by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

C. Air-Performance, Water-Penetration, and Wind-Driven Rain Ratings: As demonstrated by testing manufacturer's stock units according to AMCA 500-L.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
   1. Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

C. Samples: For each type of finish.

D. Product test reports.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Louvers:
      a. Arrow United Industries.
      b. Greenheck.
      c. Ruskin Company; Tomkins PLC.
      d. Or approved equal.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005.

C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Fabricate frames to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to louver blades with fillet welds concealed from view.

C. Join frame members to each other and to louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver:
   1. Basis-of-Design Product: Greenheck EAC-401 or a comparable product.
   2. Frame and Blade Nominal Thickness: Not less than 0.060 inch (1.5 mm) for blades and 0.080 inch (2.0 mm) for frames.
   3. Performance Requirements:
      a. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1.2-m-) wide by 48-inch- (1.2-m-) high louver.
      b. Point of Beginning Water Penetration: Not less than 700 fpm (3.6 m/s).
      c. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 700-fpm (3.6-m/s) free-area velocity.

2.5 LOUVER SCREENS

A. General: Provide screen at interior face of each exterior louver.

B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.

C. Louver Screening:
   1. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.

2.6 WALL VENTS (BRICK VENTS)

A. Extruded-Aluminum Wall Vents: Extruded-aluminum louvers and frames, not less than 0.125-inch (3.2-mm) nominal thickness, assembled by welding; with 18-by-14- (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face; incorporating weep holes, continuous drip at sill, and integral waterstop on inside edge of sill; of load-bearing design and construction.

2.7 FINISHES

A. Aluminum, Anodic Finish: Class I, clear anodic coating complying with AAMA 611.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

END OF SECTION

SECTION 10400

IDENTIFICATION, STENCILING, AND TAGGING SYSTEMS

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SECTION 10400

IDENTIFICATION, STENCILING, AND TAGGING SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Identification, stenciling, and tagging of piping, electrical equipment, valves, pumps, ductwork, process equipment and similar items, including hazard and safety signs.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 09905 - *Painting and Protective Coatings*.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American National Standards Institute (ANSI):
a. A13.1, Scheme for Identification of Piping Systems.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals*.
2. Product technical data including:
a. Acknowledgment that products submitted meet requirements of standards referenced.
b. Identification register listing all items to be identified, type of identification system to be used, lettering, location and color.
c. Catalog information for all tagging systems.
d. Updated, complete, identification register with nonconflicting numerical assignments submitted prior to project acceptance.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Metal Tags (Type A):
1. Approved manufacturers:
a. W H Brady Co., Catalog S-10, #23210 (1-1/2 IN Brass), #23211 (2 IN brass), #B-906 (2 IN aluminum).
b. National Band and Tag Co., Catalog 862, Style 81 or Style 93.
c. Carlton Industries, Inc., #8813 or #8814 (aluminum), #BT-220 or #BT-230 (brass).
d. Or approved equal.
2. Material: Brass or aluminum, optional, except where specified.
3. Size:
a. 1 1/2 IN DIA for one line of text, 2 IN DIA for two lines.
b. Brass: 0.05 IN.
c. Aluminum: 0.04 IN.
4. Legend: Stamped and filled.

B. Fiberglass Reinforced Plastic Tags (Type B):
1. Approved manufacturers and catalog numbers:
a. W H Brady Co., Catalog S-10, #B-120.
b. Or approved equal.

2. Material: Fiberglass reinforced plastic.
3. Size: Approximately 2 x 2 IN.
4. Legend: Preprinted and permanently embedded.

C. Laminated Plastic Tags (Type C):
1. Approved manufacturers and catalog numbers:
a. W H Brady Co., Catalog S-10, #B-911.
b. Or approved equal.
2. Material: Polyester laminate.
3. Size: Approximately 2 x 2 IN.
4. Legend: Preprinted and permanently embedded.

D. Fiberglass Reinforced Plastic Signs (Type D):
1. Approved manufacturers and catalog numbers:
a. W H Brady Co., Catalog S-10, #B-120.
b. Or approved equal.
2. Material: Fiberglass reinforced plastic.
3. Size:
a. Surface: As scheduled.
b. Thickness: 0.10 IN.
4. Fabrication:
a. Rounded corners.
b. Drilled holes in corners with grommets.
5. Legend: Preprinted and permanently embedded.

E. Phenolic Name Plates (Type E):
1. Approved manufacturers and catalog numbers:
a. W H Brady Co., Catalog S-10, #B-1.
b. Or approved equal.
2. Materials: Phenolic.
3. Size:
a. Surface: As required for text.
b. Thickness: 1/16 IN.
4. Fabrication:
a. Three layers laminated.
b. Legend engraved through top lamination into center lamination.
c. Drilled holes with grommets for mounting.

F. Pressure Sensitive Vinyl Cloth Markers (Type F):
1. Approved manufacturers and catalog numbers:
a. W H Brady Co., Catalog S-10, #B-946.
b. Or approved equal.
2. Material: Self-sticking vinyl.
3. Size:
a. Surface: As required by text.

G. Underground Hazard Tape (Type G):
1. Approved manufacturers and catalog numbers:
a. W H Brady Co., Catalog S-10, #91296.
b. Or approved equal.
2. Material: Polyethylene.
3. Thickness: 3.5 mils.
4. Tensile strength: 1750 psi.
5. Size: 6 IN wide (minimum).
6. Legend: Preprinted and permanently imbedded.
a. Message continuous printed.

H. Stenciling System (Type H):
1. Material:
a. Exterior type stenciling enamel.
b. Black or white for best contrast.
c. Either brushing grade or pressurized spray can form and grade.

I. Detectable Tape Material:
1. Polyethylene tape with stainless steel strip not less than 0.1 mm thick.
a. Thickness: 3.5 mils.
b. Size: 6 in. wide.
c. Legend: Preprinted and permanently embedded.

J. Substitutions:
1. Submit requests for substitutions in accordance with Specification Section 01640 - *Product Substitutions*.

K. Acceptable Manufacturers and Catalog Numbers:
1. Products listed above by manufacturer and catalog number are approved, subject to compliance with Contract Documents.

2.2 ACCESSORIES

A. Fasteners:
1. Bead chain: #6 brass or stainless steel (BC).
2. Plastic strap: Nylon, urethane or polypropylene (PS).
3. Screws: Self-tapping, stainless (screws).
4. Grommets: Stainless steel.
5. Adhesive, solvent activated.

2.3 EXTRA MATERIALS

A. Furnish minimum of 5 percent extra stock of each identification material required, including tags (not less than 3).

B. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install tagging, stenciling, and identification items at required locations.

B. Provide arrows and markers on piping and ducts.
1. At 10 FT maximum centers along continuous lines.
2. At changes in direction (route) or obstructions.
3. At valves, risers, "T" joints, machinery or equipment.
4. Where pipes and ducts pass through floor, wall, ceiling, cladding assemblies and like obstruction.
a. *Provide markers on both sides of obstruction.*

C. Position markers on both sides of pipe or duct with arrow markers pointing in flow direction. If flow is in both directions use double headed arrow markers.

D. Apply tapes and stenciling in uniform manner parallel to piping and ducts.

E. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.

F. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body area, or porous surfaces. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.

G. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing. Several items of equipment mounted in housing to be individually tagged inside the compartment.

H. Anchor for Brass Tag Attached to Concrete: 1/8" Dia. X 3" long concrete screw.

I. For electrical trenches with duct banks or direct buried cable, install underground hazard tape 6 IN below finished grade where conduit or duct bank is 12 IN or more below finished grade, and 3 IN below finished grade where conduit or duct bank is less than 12 IN below finished grade.

J. For any underground plastic pipe, install detectable metallic tape 6-12" underground, labeled according to 3.2.

3.2 SCHEDULE

A. Identify, tag, or stencil the items shown in the following schedule:

Item	ID Type	Fastener
1. Yard valves, buried, with valve box and concrete pad.	A	Brass Only, Embedded
a. Fastener: Use tag with anchor. Embed in concrete pad.		
b. Legend: Valve designation as indicated on Contract Drawings.		
2. Valves and slide gates:		
a. Exterior:	A or B	BC or PS
b. Interior:	A or B	BC or PS
c. Legend: Item designations indicated on Contract drawings.		
3. Pumps, pump motors, blowers, air compressors, and other rotating equipment:	A, B or H	Screws or Adhesive
a. Legend: Item designation as indicated on Contract Drawings.		
4. Instrumentation, e.g., flow control valves, primary elements, etc.:	A or B	BC or PS
a. Legend: Item designation as indicated on Contract Documents.		
5. Process equipment tanks and basins, e.g., EQ tank, etc:	D or H	Screws
a. Legend: Item designation indicated on Contract Documents.		
b. 7 x 10 IN		
c. Letters: 1 IN high black letters on white background.		
6. Piping:	F or H	NA
a. Legend: Item designation as indicated on Contract Documents.		
b. In accordance with ANSI 13.1.		
c. Arrows and banding arrows to indicate general flow direction.		
d. Not less than 10 FT on centers.		
7. Miscellaneous tanks.	F or H	NA
a. Legend: Item designation as indicated on Contract Drawings.		
b. Size: As required by legend.		
c. Letters: 1 IN high black letters on white background.		
8. HVAC equipment:		
a. If possible - Alternate, with approval of shop drawing by Engineer.	D or H	Screws
b. Legend: Item description as indicated on Contract Drawings.	A or B	BC or PS
c. Size: As required by legend.		
d. Letters: 1 IN high black letters on white background.		
9. Ductwork:	F or H	NA
a. Legend: Item designation as indicated on Contract Drawings.		
b. Size: As required by legend.		
c. Letters: 1 IN high black letters on white background.		
d. Arrows.		
e. Frequency: not less than 10 FT on centers.		
10. Enclosures for electrical, mechanical, and I&C equipment, e.g., motor control centers, panel boards, switchboards, safety switches, control panels, PLC's, etc., that have a name and number as shown on the Contract Drawings.	D	Screws

Item	ID Type	Fastener
a. Legend: Name and number of enclosure as indicated on the Contract Drawings. b. Size: As required by legend. c. Letters: 1 IN black letters on white background.		
11. Panel-mounted controllers: a. Controller faceplate: 1) Legend: Instrument tag number; process variable; variable units. 2) Size: As required by legend. 3) Letters: 14 IN high letters. White letters with black background b. Controller case (visible from panel back): 1) Legend: Instrument tag number. 2) Size: As required by legend. 3) Letters: 1/4 IN high letters. White letters with black background.	E	Screws or Adhesive
12. Nameplate for elements or components within or surface mounted on enclosures for electrical, mechanical, and I&C equipment including switches, instruments, etc: a. Legend: Name and number of each element or component as indicated on the Contract Drawings. b. Size: As required by legend. c. Letters: 1/2 IN high letters for element or component names and 14 IN high letters for element or component number. White letters with black background.	E	Screws
13. Electrical wiring and cables carrying 600 V or less: a. Legend: Wire or cable number as shown on Contract Drawings, on each end of each wire or cable. b. Size: As required by legend. c. Letters: Minimum 1/4 IN high yellow letters on standard background.	F	Self
14. Electrical wires and cables carrying over 600 V: a. Legend: Name of wire or cable and circuit designation. Phase designation A, B, C. Multiple conductor circuits designated A1, A2, A3, B1, etc., so each cable has unique designation. Also, brief name of circuit designation. Mark each end of each wire or cable. b. Size: 2 x 3 IN minimum. c. Letters: 1/4 IN high black letters on yellow background.	B or C	PS
15. Electrical conduit carrying over 600 V: a. Legend: Word "DANGER" followed by voltage from feeder and name and number of item being fed by feeder. Mark each end of conduit. b. Size: As required by legend. c. Letters: 1/2 IN high black letters on orange background. d. Interval:	F	Self
16. Electrical trenches with duct banks or directly buried conduit: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED ELECTRIC LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Red with black letters.	G	NA
17. Trenches with direct buried or conduit encased telephone lines: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED TELEPHONE LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Orange with black letters.	G	NA
18. Buried storm and sanitary sewer lines: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED SEWER LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Green with black letters.	G	NA

19. Buried natural gas or digester gas piping: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED GAS LINE (second line). b. Letters: 1-14 IN *minimum*. c. Interval: Continuous. d. Color: Yellow with black letters, except 3 IN and smaller irrigation pipe.	G	NA
20. Buried potable water piping: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED WATER LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Blue with black letters.	G	NA
21. Buried (non-potable water piping, except 3 IN and smaller irrigation pipe: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED NON-POTABLE WATER LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Green with black letters.	G	NA
22. Trenches with direct buried or conduit encased computer or SCADA system communications lines: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED COMPUTER LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Orange with black letters.	G	NA
23. Buried chemical feed piping, e.g. chlorine solution, polymer solution, caustic solution, etc.: a. Legend: CAUTION CAUTION CAUTION (first line), BURIED CHEMICAL LINE (second line). b. Letters: 1 1/4 IN minimum. c. Interval: Continuous. d. Color: Yellow with black letters.	G	NA
24. Hazard and Safety Signs: a. To be installed where indicated in the schedule in this paragraph below: b. Type of sign: 1) Danger signs. 2) Caution signs. 3) Safety instructional signs. c. Size: 1) As required by legend; 2) Minimum size, 7 x 10 IN, or; 3) As indicated in the schedule below or as referenced on the Drawings. d. Letters: 1) 2 IN for words "DANGER" or "CAUTION" or other words placed in the panel. 2) 3/4 IN for other text except as indicated in the schedule below. e. Danger signs: 1) White background. 2) White letters for word "DANGER" placed on standard red oval with black panel. 3) Additional letters black. 4) Additional text: As indicated on schedule below. f. Caution signs: 1) Yellow background. 2) Yellow letters for word "CAUTION" placed on black panel. 3) Additional letters black. 4) Additional text: As indicated in schedule below.	D	Screws

Item	ID Type	Fastener

g. Safety instruction signs:
   1) White background.
   2) White letters for words "SAFETY FIRST" placed on green panel.
   3) Additional letters black.
   4) Additional text as indicated in schedule below.

h. Schedule of hazard and safety signs:
   1) Include in proposal a minimum of twenty-five (25) hazard and safety signs with one half for outdoor service. Sign messages to be selected by Owner.

1

END OF SECTION

SECTION 10440

SPECIALTY SIGNS

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SECTION 10440

SPECIALTY SIGNS

PART 1 — GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTALS

A. Samples - Submit samples of each color and finish of exposed materials and accessories required for specialty signs. Architect's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

B. Shop Drawings - Submit shop drawings and schedules for fabrication and erection of specialty signs. Show anchorages and accessory items. Provide location template drawings for items supported or anchored to permanent construction.

1.3 MANUFACTURERS

A. Provide specialty signs as manufactured by one of the following:

1. Architectural Graphics, Inc.
2. Andco Industries Corporation
3. Best Manufacturing Company
4. Matthews Architectural Division
5. Mohawk Sign Systems

PART 2 — PRODUCTS

2.1 SAND-CARVED SIGNS

A. Plastic Sand-Carved Signs: Use two-color laminated ES plastic sheets, approximately 1/8" thick with radius corners. Sand carve to expose contrasting inner core color, producing raised border, tactile and braille characters. Stroke width and depth shall meet the requirements of ADA (Americans with Disabilities Act). Each sign shall be approximately 6" x 6". Color and font to be selected by Architect from manufacturer's standards.

B. Provide one sign for every interior door. Each sign shall show the name of the space and appropriate braille symbols. On sign at Toilets, also include picture symbol and the handicapped accessibility symbol.

2.2 CAST-METAL PLAQUES

A. General: Provide castings free from pits, scale, sand holes, and other defects. Comply with requirements specified for metal, border style, background texture, and finish and in required thickness, size, shape, and copy.

B. Manufacturers:

1. American Graphics Inc.
2. Matthews International Corporation; Bronze Division.
3. Metal Arts; Div. of L&H Mfg.
4. Mills Manufacturing, Inc.
5. Southwell Co. (The).

C. Bronze Castings: ASTM B 584, alloy UNS No. C83600 (No. 1 manganese bronze).

D. Border Style: Double-raised line border.

E. Background Texture: Manufacturer's standard pebble texture.

F. Mounting: Concealed studs for substrates encountered.

2.3 CONTROL SIGNS

A. Provide handicapped parking signs and posts where indicated. The signs shall comply with ADA and meet the approval of the Virginia Department of Transportation.

PART 3 – EXECUTION

3.1 INSPECTION

A. Installer must examine the substrates and conditions under which the specialty signs are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 INSTALLATION

A. Install sign units and components as directed by Architect, securely mounted with concealed fasteners, unless otherwise shown. Attach signs to substrates in accordance with the manufacturer's instructions.

B. Door signs shall be mounted on the wall on the latch side of the doors, 4" from the door frame. The top of the sign shall be mounted 64" above the finished floor.

C. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Architect.

END OF SECTION

SECTION 10505

METAL LOCKERS

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SECTION 10505

METAL LOCKERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Knocked-down, standard metal lockers.
   2. Locker benches.

1.3 DEFINITIONS

A. Uncoated Steel Sheet Thicknesses: Indicated as the minimum thicknesses.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Show base, sloping tops and other accessories.
   2. Include locker identification system.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.

B. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with ICC A117.1 and FED-STD-795, "Uniform Federal Accessibility Standards."

   1. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.

B. Deliver master and control keys to the Architect by registered mail or overnight package service.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a) Structural failures.
      b) Faulty operation of latches and other door hardware.
   2. Damage from deliberate destruction and vandalism is excluded.
   3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

C. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.

2.3 KNOCKED-DOWN, STANDARD METAL LOCKERS

A. Available Manufacturers:
   1. Art Metal Products, Div. of Fort Knox Storage Co.
   2. Lyon Workspace Products.
   3. Penco Products, Inc., Subsidiary of Vesper Corporation.
   4. Republic Storage Systems Company.
   5. Tennsco Corp.

B. Locker Arrangement: Double tier, 15" x 72".

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
   1. Tops, Bottoms, and Intermediate Dividers: 0.0209 inch, with single bend at sides.
   2. Backs and Sides: 0.0209 inch thick, with full-height, double-flanged connections.
   3. Shelves: 0.0209 inch thick, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.0528-inch thick, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

E. Doors: One-piece; fabricated from 0.0528-inch thick, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
   1. Door Style: Unperforated panel.

F. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

G. Hinges: Manufacturer's standard, steel continuous or knuckle type.

H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
   1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic and prelocking.
      a. Latch Hooks: Equip doors less than 48 inches high with 2 latch hooks; fabricated from minimum 0.0966-inch thick steel; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

I. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two master keys.
   1. Key Type: Flat or Grooved.
   2. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

J. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
   1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

K. Accessories:
   1. Continuous Base: Fabricated from cold-rolled steel sheet, manufacturer's standard thickness, but not less than 0.0528 inch thick.
      a. Height: 6 inches.
   2. Continuous Sloping Tops: Fabricated from cold-rolled steel sheet, manufacturer's standard thickness, but not less than 0.0329 inch thick.
      a. Closures: Vertical-end type.
   3. Finished End Panels: Fabricated from 0.0209-inch thick, cold-rolled steel sheet.

L. Finish: Baked enamel or powder coat.
   1. Color(s): As selected by Architect from manufacturer's full range.

2.4 LOCKER BENCHES

A. General: Provide locker benches fabricated by same manufacturer as metal lockers.

B. Bench Tops: Manufacturer's standard 1-piece units, of the following material, minimum 9-1/2 inches wide by thick, with rounded corners and edges:
   1. Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
   1. Tubular Steel: 1-1/4-inch diameter steel tubing, with 0.1265-inch thick steel flanges welded at top and base; with baked-enamel finish; anchored with exposed fasteners.
      a. Color: As selected by Architect from manufacturer's full range.

2.5 FABRICATION

A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
   1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.

2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Knocked-Down Construction: Fabricate metal lockers for nominal assembly at Project site using nuts, bolts, screws, or rivets. Factory weld frame members together to form a rigid, one-piece assembly.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch high.

F. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.

H. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

2.6 STEEL SHEET FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

D. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

E. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers.

B. Knocked-Down Metal Lockers: Assemble knocked-down metal lockers with standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
   1. Attach hooks with at least two fasteners.
   2. Attach door locks on doors using security-type fasteners.
   3. Identification Plates: Identify metal lockers with two digit numbers.
      a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
   4. Attach sloping top units to metal lockers, with closures at exposed ends.
   5. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

D. Fixed Locker Benches: Provide not less than 2 pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHER CABINETS

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SECTION 10522

FIRE EXTINGUISHER CABINETS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fire protection cabinets for the following:
      a. Portable fire extinguishers.

B. Related Sections:
   1. Division 10 Section "Fire Extinguishers."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
   1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.6 SEQUENCING

A. Apply vinyl lettering on field-painted, fire protection cabinets after painting is complete.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.

C. Stainless-Steel Sheet: ASTM A 666, Type 304.

D. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.2 FIRE PROTECTION CABINET (FEC)

A. Cabinet Type: Suitable for fire extinguisher.
   1. Products: Subject to compliance with requirements, provide one of the following manufacturers:
      a. J. L. Industries, Inc., a division of Activar Construction Products Group;
      b. Larsen's Manufacturing Company;
      c. Potter Roemer LLC;

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Steel sheet.

D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

E. Rolled-Edge Trim: backbend depth.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Solid opaque panel with frame.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide manufacturer's standard.
   2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:
   1. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
   2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
      a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet door.
         2) Application Process: Pressure-sensitive vinyl letters.
         3) Lettering Color: White.
         4) Orientation: Horizontal.

K. Finishes:
   1. Manufacturer's standard baked-enamel paint for the following:
      a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
      b. Interior of cabinet and door.
   2. Steel: Baked enamel or powder coat.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.

2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of .
1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
1. Fire Protection Cabinets: above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.

C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10523

FIRE EXTINGUISERS

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SECTION 10523

FIRE EXTINGUISERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and maintenance data.

C. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers, that fail in materials or workmanship, within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire extinguisher indicated.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ansul Incorporated; Tyco International Ltd.
      b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
      c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
      d. Larsen's Manufacturing Company.
      e. Potter Roemer LLC.
   2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated 4A-80B:C, 10 lb nominal capacity, with mono ammonium phosphate-based dry chemical in manufacturer's standard enameled container. Quantity: Seven (7).

C. In Electrical Rooms, provide Class C, Carbon Dioxide (CO_2) type fire extinguisher rated for the application. Quantity: Three (3).

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
      a. Orientation: Vertical.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: 54" above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 10800

TOILET ACCESSORIES

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SECTION 10800

TOILET ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification Sections, apply to this Section.

1.2 SUBMITTALS

A. Submit manufacturer's data and installation instructions for each accessory for Architect's review and approval.

1.3 DESCRIPTION OF WORK

A. The extent of each type of toilet accessory is shown on the drawings and specified herein.

B. This Section includes:
   1. Toilet and bath accessory items.
   2. Utility Room Accessories.

1.4 PRODUCTS

A. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same areas, wherever possible.

1.5 MANUFACTURER

A. Provide toilet accessories as manufactured by one of the following:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment, Inc.
   3. Bradley Corporation
   4. McKinney/Parker, Essex Industries, Inc.
   5. Or approved equal.

PART 2 – PRODUCTS

2.1 TOILET PAPER DISPENSER

A. Surface mounted toilet paper holder unit shall hold and dispense one roll of standard core roll tissue up to 5-1/2" in diameter. Unit shall be fabricated of 18-8 stainless teel, type 304. Mounting plates shall be included. Posts shall be fabricated of ½' x 1" rectangular tubing. Roller shall be chrome-plated high-impact resistant ABS plastic. All exposed surfaces shall be satin finish. Provide one unit at each water closet.

2.2 MIR: MIRROR WITH SHELF

A. Stainless steel framed mirror with shelf shall be fabricated of alloy 18-8 stainless steel, type 304, 18 gauge with mitered corners welded and polished. Structural reinforcement gussets shall be of welded construction. Mirror glazing shall be No. 1 quality, 1/4" thick plate/float, silver coated and hermetically sealed with a uniform coating of electrolytic copper plating, warranted against silver spoilage for 15 years. All edges of mirror shall be protected with friction and chafe absorbing fillers. Back of mirror shall be protected by full size shock-absorbing water resistant filler and full size one piece 20 gauge corrosion protected steel. An 18 gauge corrosion protected steel "H" bracket shall be supplied. Mirror shall be secured to vertical brackets with corrosion protected allen head locking screws. All exposed surfaces shall have a no. 4 satin finish.

2.3 SCR: SHOWER CURTAIN, ROD, AND HOOKS:

A. Shower curtain shall be fabricated of .008" thick vinyl treated with Macrobiotic KV-33 anti-bacterial, anti-fungal and anti-mildew agent, and flame retardant agents. Protection agents shall remain in effect after repeated low-temperature mild soap washing and air-drying cycles. Top hem shall be 1-1/2" wide, backing reinforced and heat-sealed above and below grommet row. Bottom hem and vertical edges shall be plain edge. Clear anodized aluminum grommets with 3/8" inside diameter shall be machined into top hem at 6-1/2" intervals on centers starting a 1-1/4" from edges. Color shall be white.

B. Heavy-duty shower curtain rod with flanges shall be fabricated of alloy 18-8 stainless steel, type 304. Tubing shall be 20 gauge, 1" dia. with a satin finish. Mount at 72-1/2" above finished floor.

C. Shower curtain hooks shall be fabricated of type 304 stainless steel alloy 18-8. Solid formed wire shall be .098" diameter with a bright finish. Hooks shall have a formed retainer to hold free end closed and shall accommodate 1" to 1-1/4" diameter curtain rods.

2.4 CH: COAT HOOKS

A. Single robe hook shall be fabricated of stainless steel alloy 18-8, type 304. Post shall be 1/2" x 1" rectangular tubing with formed mounting flange and bracket welded on end. Cap plate shall be 14 gauge, 3/4" x 1-1/4" with radiused corners and internally welded to outer end. Mounting plat shall be 18 gauge. A stainless steel setscrew shall be provided on bottom perimeter fo flange to lock unit to mounting plate. Surface finish shall be satin. Mount top of hook at 46" above finished floor. Provide one at each toilet compartment.

2.5 GB: GRAB BARS

A. Provide stainless steel grab bars with concealed mounting, 1-1/2" o.d., wall thickness 0.49" (18 ga.), with peened, knurled, or striated non-slip gripping surface, capable of supporting 250 pounds. 42", 36" and 18" long. Mount as shown on the Drawings. Provide one set at each handicap stall.

2.6 TR: TOWEL RING

A. Towel ring shall be fabricated of stainless steel alloy 18-8, type 304. Support post shall be 1/2" x 1" rectangular tubing with formed mounting flange and bracket welded on end. Ring shall be formed from 1/4" diameter stainless steel rod. Mounting plate shall be included and shall be 18 gauge. A stainless steel setscrew shall be provided on bottom perimeter of flange to lock unit to mounting plate. Surface finish shall be satin. Mount at 48" above finished floor. Provide one at each shower compartment.

2.7 US: UTILITY SHELF

A. Utility shelf with mop holders, drying rod and rag hooks shall be fabricated of 18 gauge alloy 18-8 stainless steel, type 304. Utility shelf shall have 2-1/2" side hemmed-in edge all around and length shall be 30". Three rubber-cam mop-holders shall be provided at the face of the shelf. Mop holder brackets shall be fabricated of cadmium plated steel and shall be ribbed for rigidity. Each mop holder shall have a pivoting spring loaded serrated rubber cam that shall hold round handles of 7/8" to 1-1/4" diameter wedged against ribbed clamp plate. A 3/8" diameter stainless steel drying rod shall be provided to run between the mounting bracket gussets. Mounting brackets shall be 16 gauge. Provide with two stainless steel rag hooks. All exposed surfaces shall be No. 4 satin finish. Mount at 72" above finished floor. Provide one unit in Janitor 109.

2.8 PTD: PAPER TOWEL DISPENSERS

A. Dispenses 200 C-fold or 275 Multi-fold paper towels; entire unit fabricated of 22 gauge stainless steel. Approximate size: 11"x8"x4". Mount at 40" above finished floor to towel slot.

2.9 SD: SOAP DISPENSER

A. Surface mounted horizontal soap dispenser shall have a capacity of 40 fluid ounces of liquid or lotion soaps, synthetic detergents and antibacterial soaps. Dispenser shall be fabricated of 20 gauge stainless steel, alloy 18-8, type 304. All exposed surfaces shall be No. 4 satin finish. Valve shall be constructed of a plastic valve body and push button with stainless steel and plastic internal parts. Valve operation shall comply with ADA Accessibility Guidelines by requiring no more than 5 lbs. pressure to actuate and require not grasping or twisting by operator. A tamper resistant sight gauge shall be provided. Unit shall have a hinged stainless steel refill door on top of unit, which is opened with special key provided. Provide one at each lavatory.

PART 3 – EXECUTION

3.1 INSPECTION

A. Installer must examine the areas and conditions under which toilet accessories are to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 INSTALLATION

A. Install with concealed mounting devices and fasteners fabricated of the same material as the accessories, or of galvanized steel, as recommended by manufacturer. Secure toilet room accessories to adjacent walls and partitions complying with the manufacturer's instructions for each item and each type of substrate construction.

END OF SECTION

SECTION 11005

EQUIPMENT: BASIC REQUIREMENTS

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 03002 - *Concrete.*
   4. Section 07900 - *Joint Sealants.*
   5. Section 09905 - *Painting and Protective Coatings.*
   6. Section 10400 - *Identification, Stenciling, and Tagging Systems.*
   7. Section 13442 - *Primary Elements and Transmitters.*
   8. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   9. 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 area and NEMA 250 and ICS-6 designations.

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 supported with 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. Acknowledgment 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. Working and test pressure ratings, if applicable.
   2. Equipment utility requirements include air, natural gas, electricity, and water.
   3. Mechanical and process equipment:
      a. Operating characteristics:
         1) Technical information including applicable performance curves showing specified equipment capacity, range ability, 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.
   4. Electrical and control equipment:
      a. Electric motor information:
         1) Nameplate data.
         2) Service factor on motors ½ HP and above.
         3) Motor enclosure type.
         4) NEMA frame size, if applicable.
         5) NEMA design code, if applicable.
         6) Insulation type.
         7) Locked rotor current on motors 10 HP and above.
         8) Efficiency and power factor at full load, 3/4 load, ½ load and ¼ load.
         9) Stall time (hot and cold) for motors 125 HP and larger.

10) Power factor correction data for motors 10 HP and larger. Provide recommendation from motor manufacturer giving highest capacitor size in KVAR that may be used with each motor, or provide motor manufacturer's published curve based on factory tests, showing plot of power factor versus load. For electric motors greater than 75 HP, submit the following additional information.
    a) Motor current, efficiency and power factor at:
        (1) Full load, 3/4 load, ½ load and no load.
        (2) Locked rotor current.
        (3) Stall time damage point.
        (4) Overload damage curve.
    b) Motor test reports demonstrating motor capabilities equal to or in excess of the following standard defined criteria.
        (1) Overspeed by NEMA MG 1-12.48.
        (2) Noise by NEMA MG 1-12.49.
        (3) Number of starts by NEMA MG 1-12.50.
        (4) Routine tests by NEMA MG 1-12.51.

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.

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 n 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 anyway way with other controls or panels have been submitted o 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. Siemens Allis.
        b. Westinghouse.
        c. General Electric.

d. U.S. Motors.
e. Or approved equal.

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 drives, provide motors fully compatible with the variable speed controllers.
3. Where frequent starting applications are specified, design for frequent starting duty equivalent to duty service required by driven equipment.
4. Rate for continuous duty at 40°C ambient. Design in accordance with the NEMA Standards for Class F insulation with Class B temperature rise above 40°C ambient on continuous operation or intermittent duty at nameplate horsepower.
5. Design for full voltage starting.
6. Design bearing life based upon actual operating load conditions imposed by driven equipment.
7. Size for altitude of Project.
8. 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.
9. Provide encapsulated windings in wet/corrosive 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.
10. Furnish with clamp-type grounding terminals inside motor conduit box.
11. Furnish motors with oversized conduit boxes. Boxes shall comply with the National Electrical Code for pull box size based on the conduits entering the box. Boxes for the High Service Pump motors shall have three 3 inch conduit openings in the bottom of box. Boxes for the Backwash Pump motors shall have one 2 inch conduit opening in the bottom of the box.
12. Furnish with stainless steel nameplates with information to include all data as required by paragraph 430-7 of the National Electric Code, NFPA 70.
13. 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.
14. Electric motors less than 1/3 HP.
   a. Single phase, 60 HZ, suitable for supply voltage shown on Drawings.
   b. Totally enclosed non-ventilated (TENV) or totally enclosed fan cooled (TEFC).
   c. Permanently lubricated sealed bearings conforming to AFBMA Standards.
   d. Built-in manual-reset thermal protector or furnished with integrally mounted stainless steel enclosed manual motor overload switch.
15. Electric motors 1/3 to 1 HP inclusive:
   a. Single or 3 PH, 60 HZ, suitable for supply voltage and phase shown on Drawings.
   b. Totally enclosed non-ventilated (TENV) or totally enclosed fan cooled (TEFC).
   c. Specially insulated for use in damp locations below 20°C.
   d. Permanently lubricated sealed bearings conforming to AFBMA Standards.
16. Electric motors 1½ through 10 HP:
   a. 230/460 V, 60 HZ, 3 PH voltage supply.
   b. Totally enclosed fan cooled (TEFC).
   c. Specially insulated for use in damp locations below 20°C.
   d. Permanently lubricated sealed bearings conforming to AFBMA Standards.
   e. For vertical motors, provide 15-year, average-life thrust bearings conforming to AFBMA Standards.
17. Electrical motors greater than 10 HP.

a. 230/460 V, 60 HZ, 3 PH supply voltage.
b. Totally enclosed fan cooled (TEFC).
c. Specially insulated for use in damp locations below 20°C.
d. Oil or grease lubricated anti-friction bearings conforming to AFBMA 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.
e. Thermal protection:
   1) Two integral thermal protectors per phase for motors 100 HP and larger suitable for connection in pilot control circuit.
   2) Provide two Resistance Temperature Detectors (RTD) per phase in the High Service Pump motors wired out to an RTD terminal box separate from the power terminal box. Coordinate the RTDs with the Minco RTD controller shown on the electrical drawings.
   3) Where motors are located in hazardous classified areas Divisions 1 and 2, provide box for potting compound to seal connections in accordance with NEMA MG 1-12.52.
f. For vertical motors, provide 15-year average life thrust bearings conforming to AFBMA Standards.

18. Motors 15 HP and above having a locked rotor inrush KVA greater than 6.3 times motor horsepower are not acceptable.
19. Motor efficiencies:
    a. Provide motor having following minimum efficiencies.
       1) Vertical induction motors:

	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	DPFG		DPFG		DPFG		DPFG	
HP	TEFC	WP-I	TEFC	WP-I	TEFC	WP-I	TEFC	WP-I
1	75.5	---	75.5	78.5	72.0	74.0	68.0	68.0
1.5	73.5	---	77.0	78.5	72.0	68.0	72.0	68.0
2	74.0	77.0	75.5	74.0	75.5	75.5	72.0	68.0
3	75.0	80.0	76.0	78.5	75.5	75.5	72.0	72.0
5	79.0	78.5	81.0	78.5	78.5	78.5	77.0	77.0
7.5	81.5	81.5	84.0	81.5	81.5	78.5	81.5	81.5
10	82.0	81.5	86.5	84.0	84.0	81.5	81.5	81.5
15	81.0	84.0	86.5	84.0	84.0	84.0	84.0	84.0
20	84.0	84.0	86.5	84.0	86.5	84.0	86.0	84.0
25	86.5	84.0	88.5	84.0	88.5	86.5	87.0	86.5
30	86.5	86.5	88.5	86.5	88.5	86.5	87.5	84.0
40	88.5	86.5	88.5	86.5	90.2	86.5	88.5	87.0
50	88.5	88.5	90.2	88.5	90.0	88.5	90.2	88.5
60	88.5	88.5	90.2	90.2	90.2	88.5	90.2	88.5
75	90.2	88.5	90.2	90.2	90.2	90.2	90.2	90.2
100	90.2	90.2	91.7	90.2	91.7	90.2	91.0	90.2
125	90.2	90.2	91.7	91.7	91.7	91.7	91.5	89.5
150	90.2	90.2	91.7	91.7	91.7	91.7	91.7	90.5
200	91.5	90.2	93.0	93.0	91.7	91.5	92.5	91.0
250	91.5	90.2	92.5	92.5	93.0	91.5	92.5	91.0
300	91.7	93.1	93.0	92.0	93.0	91.5	--	92.0
350	93.5	92.5	93.0	92.0	--	92.0	--	92.0
400	94.0	93.5	93.0	92.5	--	92.5	--	92.0
450	--	93.5	--	92.5	--	92.8	--	92.2
500	--	93.5	--	93.0	--	92.8	--	92.2
600	--	--	--	93.5	--	93.3	--	--
700	--	--	--	93.5	--	93.3	--	--
800	--	--	--	93.5	--	--	--	--
900	--	--	--	93.5	--	--	--	--

2) Horizontal induction motors:

	3600 RPM		1800 RPM		1200 RPM		900 RPM	
	DPFG		DPFG		DPFG		DPFG	
HP	TEFC	WP-I	TEFC	WP-I	TEFC	WP-I	TEFC	WP-I
1	71.0	71.5	78.5	75.5	75.5	73.0	67.5	68.0
1.5	80.0	78.5	81.5	81.5	81.5	81.5	69.5	68.0
2	81.5	80.0	81.5	80.0	84.0	82.5	72.0	68.0
3	84.0	80.0	86.5	84.0	86.5	82.5	72.0	72.0
5	85.5	82.5	86.5	85.5	86.5	84.0	78.5	78.5
7.5	86.5	84.0	88.5	88.5	87.5	87.5	81.5	81.5
10	87.5	85.5	88.5	88.5	88.5	87.5	81.5	81.5
15	88.5	87.5	90.2	91.0	89.5	91.0	84.0	84.0
20	89.5	89.5	90.2	91.0	89.5	89.5	86.5	85.5
25	89.5	90.2	91.0	91.8	90.2	89.5	87.5	86.5
30	89.5	90.2	91.7	92.4	91.0	91.0	88.5	84.0
40	90.2	90.2	93.0	91.0	91.7	91.0	89.5	88.5
50	90.2	90.2	93.0	91.7	91.7	91.7	90.2	88.5
60	91.0	90.2	93.0	92.4	93.0	91.7	90.2	88.5
75	93.0	91.7	93.0	92.4	93.0	91.7	90.2	90.2
100	93.0	91.7	94.1	93.0	93.0	93.0	91.7	90.2
125	93.0	92.4	94.1	93.0	93.0	93.0	91.7	90.2
150	93.0	92.4	94.1	93.6	94.1	93.0	91.7	91.4
200	94.1	91.7	94.4	94.1	94.1	93.6	93.0	91.7
250	93.7	91.7	95.2	93.0	94.5	93.0	91.0	91.0

20. Measure efficiencies by IEEE 112 - Method B (Method E may be used for vertical motors 50 HP and larger Vertical motors may eliminate thrust bearing losses for efficiency measurements).
21. Provide two Resistance Temperature Detectors (RTD) per phase in the High Service Pump motors wired out to an RTD terminal box separate from the power terminal box. Coordinate the RTDs with the Minco RTD controller shown on the electrical drawings.

B. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment. Adjustment mechanism to be 304 stainless steel.
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 ½ 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 per Section 03308.
b. Threaded rods same as cast-in-place.

C. Data Plate:
1. Attach a stainless steel data plate to each piece 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 reciprocating, centrifugal and positive displacement mechanical and process equipment.
b. At locations identified on Drawings.
3. Utilities 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.

F. Materials:
1. All materials in contact or potentially in contact with process water shall be NSF 60 certified.

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. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 09905.

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. Switchgear.
      e. Safety switches.
      f. Motor starter equipment.
      g. Motor control centers.
      h. Busways.
      i. Raceways and cable trays.
      j. Transformers.
      k. Engine generator sets.
      l. Power circuit breakers.
      m. Exterior substation galvanized structural steel.
   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 {09906}.

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 procedures. Include the following:
      a. Routine test:
         1) Running no-load amperes.
         2) Locked rotor amperes.
         3) Winding resistance, DC.
         4) High-potential test at twice rated voltage plus 1000 V, with a minimum of 2200 V for 1 minute, winding to ground.
         5) Vibration check.
         6) Wound-rotor motor, secondary volts at collector rings.

b. Complete test:
   1) Rated load temperature rise.
   2) Slip in percent.
   3) Locked rotor amperes (3 PH, full voltage).
   4) Locked rotor torque.
   5) Breakdown torque.
   6) High potential test; see paragraph 4) above.
   7) Efficiencies tabulated at 100, 75, and 50 percent of full load.
   8) Power factor tabulated at 100, 75, and 50 percent of full load.
   9) Wound - rotor motor, secondary volts at collector rings.

2. Provide routine test for motors 5 through 75 HP. Test all motors.
3. Provide routine and complete test for motors 100 HP and larger. Test all motors. Commercial test will be acceptable if test results can be compared to results from identical motors and projected to the results for a complete test.
4. The Owner reserves the right to, at any time, select and have tested any motor included within the Project. If motor passes testing requirements, Owner will be responsible for any shipping and testing costs incurred. Costs shall be determined by current freight rates and manufacturer's published rates at the time of the test. If motor fails test, Contractor shall be responsible for all costs incurred. If two successive motors fail the test, the Owner has the right to reject any or all motors from that manufacturer. The Owner also reserves the right to witness any routine or complete tests at Owner's expense.

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 subbases, 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 subbases in manner that they are level in both directions according to machined surfaces on base. Use machinist level for his procedure.
   2. Level machine bases on subbases and align 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 1½ 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 form work shall be placed around base to contain grouting. Extend dam or form work at least ½ 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 form work 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 start up 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 job site.

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 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs in accordance with Section 10400.

3.4 FIELD PAINTING AND PROTECTIVE COATINGS

A. For required field painting and protective coatings, comply with Section 09905.

3.5 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape uninsulated conductors and connectors with electrical tape, 150 percent of insulation value of conductor.

E. Connections to carry full capacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

3.6 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. For motor 50 HP and above, conduct insulation resistance (megger) test on each motor before energized. Conduct test with 500 or 1000 V DC megger. Test each phase separately and follow procedures listed below:

1. Disconnect voltage sources, lightning arrectors, capacitors, and other potential low insulation sources from motor before connecting megger to motor.
2. When testing a phase, connect phases not under test to ground.
3. Apply test voltage, phase to ground, on each phase being tested. Record resistance reading at 30 seconds and at one minute after test voltage is applied. Divide one minute reading by 30 second reading to obtain dielectric absorption ratio (DAR). DAR must be 1.25 or greater for phase to pass test.
4. If phases have a DAR of 1.25 or greater, attach a tag to the motor and mark tag "Insulation Resistance Test OK" and sign.
5. Connect equipment removed in paragraph 1 above.

D. 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.

E. 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.

3.7 DEMONSTRATION

A. Demonstrate equipment in accordance with Section 01650.

END OF SECTION

SECTION 11025

FILTER UNITS

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SECTION 11025

FILTER UNITS

PART 1 – GENERAL

1.1 SUMMARY

A. All of the equipment described in this section shall be supplied by a single manufacturer regularly engaged in the business of providing water treatment plant filter products. The work includes the installation of seven (7) new filter units including backwash troughs, air scour equipment, gravel filter media and controls in new and existing filter bays. Filter Nos. 1, 2, 3, 5, 6, 7, and 8 will be provided with new equipment. The controls require the coordination and control of all filters.

1. Equipment provided in this section will include:
   a. Filter underdrain.
   b. Fiberglass filter troughs.
   c. Air scour unit.
   d. Filter media.
   e. Filter controls and control panels.

B. Filter No.4 was upgraded in the interim expansion and already has new filter media, under drains, and air scour grid. It will require new troughs, controls and panel, and air scour connections. It will require an additional 4" of anthracite media and 3" of filter sand media, matching those specified in this Section.

C. Related Sections include but are not necessarily limited to:

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 11005 - *Equipment: Basic Requirements.*
4. Section 17000 - *Control Information Systems Scope and General Requirements.*
5. Section 17950 - Functional Control Descriptions.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society for Testing and Materials (ASTM).
2. American National Standard Institute (ANSI).
3. American Water Works Association (AWWA).
4. National Sanitation Foundation (NSF).

B. Qualifications:

1. The filter unit shall be supplied by one manufacturer who shall assume total responsibility for the parts operating as a whole.
2. The filter unit shall be a standard product of a manufacturer who has been actively providing similar underdrain equipment for at least 15 years.
3. Qualification Requirements: Equipment Supplier shall submit the following information upon request by Engineer within fifteen (15) calendar days of receipt of such request. Evidence of previous performance by submitting the following information and samples to the Engineer:
   a. Operator names and contact information, including current telephone numbers for a minimum of four (4) installations of the manufacturer's underdrains and air scour systems similar to those proposed for the Owner that have been in service for at least ten (10) years. These systems shall have been filtering water at filter rates similar to the proposed filter. Installations without current telephone numbers will not be considered.
   b. Operational data from the installations listed above. This documentation shall include:
      1) Media bed surveys showing filter support media contours and filter media contours after a minimum of 10 years of filter operation;

2) Backwash rise rate contours after a minimum of 10 years of filter operation.
3) Operational data including influent and effluent turbidity measurements, chemicals used, etc.
4) Filter media specifications.
5) Pictures of installed underdrains and air scour system.
6) Provide pictures showing:
   a) Details of air scour system.
   b) Details of underdrain system, including bridging of effluent trough and installation techniques.

c. Provide engineering reports stating degree of water and air distribution, description of hydraulics, headlosses for backwash and filtration, including description of test facility and method, methods of sampling and calculations. Also, include description of materials used for underdrains and air scour equipment and describe the installation process.

d. Provide a listing of water treatment plants, including current operators names in which similar underdrains and air scour systems have been installed including operator names and current telephone numbers. Installations without current telephone numbers will not be considered an installation. The manufacturer must have at least 30 installations.

e. The backwash trough manufacturer shall present evidence of five (5) installations of fiberglass troughs built and installed by them that have served satisfactorily for at least five (5) years. Contact information will include current phone numbers.

C. Certification:

1. All materials used in contact with the water and backwash air shall meet National Sanitation Foundation (NSF) Standard 61 Drinking Water System Components - Health Effects.

1.3 SUBMITTALS

A. Submit to the engineer complete shop drawings showing details of fabrication, materials of construction, installation and leveling instructions for all items furnished under this section.

B. Details submitted shall include as a minimum, headloss data for air, water and combined air/water backwash, structural design calculations, installation details, flow distribution calculations, certification of compatibility of the underdrain system with the filter media specified in this section, details for installing reinforcing and other items to be embedded in concrete, controls information including panel information, backwash, and flow sequencing.

C. Submit detailed procedures for testing of all components, including air scour piping and valves, underdrain grouting, and connection to base slab.

D. Proper documentation showing NSF-61 certification of all underdrain components.

E. The media submittal and technical information will be provided and approved by a licensed engineer regularly employed by the filter manufacturer. The engineer shall have at least 15 years experience in water treatment. The submittal shall include the following information as a minimum:

1. Supplier's name.
2. Quality control manual.
3. Gradation of each media type.
4. Date of sampling/lot number.
5. Samples of each media type from each type of media supplied.
6. Representative sample analysis (i.e., effective size, uniformity coefficient, specific gravity, acid solubility and MOH hardness for Anthracite only).
7. Material quantities.
8. Diagram with type of material and depth of each.
9. Estimated shipping schedule.
10. Media loading procedure.
11. All testing shall conform to the requirements of the latest edition of AWWA B100.

F. Submit full backwash procedure recommendations including filter to waste procedures and recommendations on initial filter ripening.

G. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*

H. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

1.4 DESCRIPTION

A. Work Included: Furnish all labor, materials, tools and equipment necessary to:
   1. Demolish existing underdrain and surface wash equipment in Filters 1-3.
   2. Install filter media and filter media support gravel within the filter boxes in a sequence that allows 4 filters to remain in operation at all times.
   3. Install air scour systems designed to inject air into fixed air grid.
   4. Install underdrain systems in filter boxes.
   5. Install new fiberglass backwash troughs.
   6. Install controls for all 8 filters.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. See Section 01062 - *Major Equipment Suppliers.*

2.2 EQUIPMENT

A. Filter Underdrain:
   1. The filter underdrain system shall be designed and installed to ensure long term stability in its operating characteristics. It shall be resistant to changes in head loss, flow uniformity, and any other effects, which would in time cause loss of efficiency or effectiveness in its operation. The underdrain shall utilizes a "low profile" design with the nominal height being 8 inches or less.
   2. The underdrain system is intended to allow for the uniform collection of filtered water and uniform distribution of backwash water over the total area of the filter floor. The system shall be able to handle an air/water backwash.
   3. The system shall be designed to avoid localized areas of excessive flow (maldistribution), which may cause mounding, lateral displacement, or other deleterious disturbances in the filter support gravel or media.
   4. When subjected to a flow rate of 20 gpm/sf of filter area the headloss through an underdrain lateral 17 feet long shall not exceed 35 inches water column when the water temperature is approximately 60° F.
   5. Design Flow Rates: The filter underdrain system shall be furnished and installed to perform satisfactorily and as specified when operated under the following conditions:
      a. Downflow of filtered water up to 5 gpm/sf.
      b. Upflow of backwash water. Upflow of backwash water up to 20 gpm/sf.
   6. Flow Distribution: The filter underdrain system, as installed, shall provide acceptable flow uniformity. Maldistribution (MD) of air and water flows during backwash shall be as follows:
      a. The maldistribution in a lateral 8 feet long or less shall not exceed 3 percent of the average gpm/sf of filter for a backwash rate of 20 gpm/sf.
      b. Additional maldistribution, due to specific flume arrangement, entry conditions into both flume and underdrain laterals and flow velocities, must be considered in the above calculation.
   7. Structural Design Requirements:
      a. The filter underdrain system, including anchorage, supports, etc. shall be designed to safely withstand loadings for the specified conditions, with a safety factor of at least two.

b. The filter underdrain system, when installed, shall be designed for a net internal loading during backwash of the greater of either 600 psf or 200 percent of the maximum pressure at maximum backwash rates. No credit shall be taken for the weight of gravel or filter media.
c. The filter underdrain system shall also be designed to withstand a net downward loading of not less than 1,400 psf.

8. Grout:
   a. Cement shall be standard brand Portland cement conforming to ASTM C150, Type II, for general use. Cement that has become "lumpy" shall not be used. Do not use non-shrink grout.
   b. Water for mixing and curing shall be clean and clear potable water. Water with a total dissolved solids of 1000 mg/l or higher, shall not be used.
   c. Sand shall be clean and washed masonry sand. When tested in accordance with ASTM D2419, the sand equivalency shall not be less than 90% for an average of three samples, or less than 85% for any individual sample. 100% of sand particles shall pass No. 4 sieve and not more than 4% of sand particles shall pass No. 200 sieve.
   d. The grout used in installing the blocks shall have a minimum compressive strength of 3000 psi after 30 days of curing. Use a grout with one part Portland cement and two parts clean silica sand properly mixed and wetted with a maximum water-cement ratio by weight equal to 0.50 to 0.55 for the base grout and 0.61 to 0.67 for the fill grout.

B. Gravel Support Layers:

1. The underdrains shall be covered with a minimum of 12" of gravel support layers, arranged carefully in 4 layers, each placed separately. Each gravel layer shall consist of clean, hard, durable, rounded particles of washed gravel having a specific gravity of not less than 2.6. The gravel shall contain not more than 2% by weigh of thin, flat, or elongated pieces (pieces having a ratio of largest dimension to smallest dimension greater than 5:1) as determined by hand picking from a representative sample. The gravel shall be washed free from shale, mica, sand, clay, loam, and organic impurities of any kind. The washed and dried gravel, when digested for a period of 24 hours in cold, strong hydrochloric acid, shall not suffer weight loss in excess of 5%. The percent voids in any layer shall not be less than 35% nor greater than 45%.
2. Particles and installation of gravel layers shall conform to the latest revision of AWWA Specification B100.
3. The gravel layers shall be sized as follows:

a.	Top	3"	1/8" x No. 10 Sieve Opening
b.	Middle Top	3"	¼" x 1/8"
c.	Middle Bottom	3"	½" x ¼"
d.	Bottom	3"	¾" x ½"

C. Filter Media:

1. Furnish and install under this section suitable filter media. The media system shall be capable of sustained operation at rates to 5 GPM per sq. ft. of filter area, filtering properly treated and settled water without excessive use of backwash water or undue rate of head loss buildup. All media and support gravel shall be furnished by a single supplier.
2. Samples of each type of media shall be submitted to a licensed and recognized testing laboratory by the media supplier for a full and complete analysis to assure compliance with these specifications. A report of the media composition shall be submitted to the Engineer prior to installation.
3. Particles and installation of media layers shall conform to AWWA Specification 0B100.
4. The media system shall be installed in accordance with the manufacturer's specific detailed instructions provided to the Engineer during the shop submittal phase, and the manufacturer shall provide supervision of the installation for the filter to insure proper compliance with the installation specifications by the Contractor. Extreme care shall be exercised in the placing of all filter media to avoid damage or displacement of the filter bottom or previously placed media. The manufacturer's specific detailed instructions for installation of filter media shall be in accordance with AWWA standards.

5. Filter sand shall be composed of hard, durable clean siliceous particles, free of all mica with an average specific gravity of 2.65 (±.05) and shall be in strict accordance with AWWA B100, and have an effective size of 0.40 - 0.50 mm, and a uniformity coefficient of 1.50 or less, for a finished depth after backwashing and scraping and removal of fines and debris of 12 inches. A 1/2-inch skimming allowance shall be provided.
6. Filter anthracite shall be composed of specially selected and graded hard, durable anthracite coal particles. The anthracite shall be composed entirely of deep mined material. The anthracite shall have an average specific gravity of 1.65(±0.05) with a hardness (MOH scale) of 2.7 or more and shall be essentially free of iron, clay, shale, extraneous dirt, and excessive dust with moisture less than 4.0 percent as shipped. The anthracite shall be in accordance with AWWA B100, and have an effective size of 0.80 - 0.9 mm, and a uniformity coefficient of 1.50 or less for a finished depth after backwashing and scraping and removal of fines and debris of 23 inches. A skimming allowance of 1 inch shall be provided.

D. Filter Backwash Trough:
1. The Contractor shall furnish and install wash troughs in the new filter. Trough shall be embedded in and keyed to the grouted portion of the gullet wall. An integral end plate, forming the other end of the trough, shall bolt to threaded anchors set in the backwall and be spaced away from the wall with ¼ inch fiberglass washers to allow thermal expansion of the trough shell. Full-span angles shall be bolted to the inside of the trough with bolts in slotted holes in 6 inch centers in such a way as to serve as weir edges with 1 inch of vertical adjustment. The angles shall be braced transversely with solid FRP or PVC bars at the gullet. For operation all weir edges shall be adjusted to within 1/16 inch of level. Installation shall be in accordance with manufacturer's recommendations. The trough shall be blue in color.
2. Trough shall be sized adequately to allow 16" valve to be installed inside it as shown on the Drawings.
3. Provide bracing designed to eliminate the possibility of weir oscillation at the top of the trough.
4. Loadings - The troughs shall be designed to fully span the filter with no external supports or braces and shall handle the following loadings:
   a. Gravity Load - Downward vertical loads shall include the weight of the trough and appurtenant attachments, such as weir plates and the spreader bars, together with the weight of water to fill the trough. Any additional loads, such as piping, etc., shall also be considered.
   b. Buoyant Load - The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected). The line of action passes through the centroid of the submerged cross-sectional area.
   c. Lateral Load - Loads acting against the trough side walls; specifically, those induced by differential water levels on either side of the trough walls. The maximum possible differential, existing when the trough is empty and the tank is full, or when the trough is full and when the tank is empty, shall be used when calculating deflection, fiber stress, etc.
   d. Thermal Stresses - The troughs shall be designed to accommodate temperature induced stresses resulting from differences in coefficients of thermal expansion (contraction) between the trough and tank/support materials.
   e. Torsional Stability - The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Any or all of the following trough stabilization techniques shall be considered.
      1) Trough-to-trough stabilization
      2) Torsional stiffness
      3) Support spacing and rigidity
      4) Internal baffles and/or flow straighteners
   f. Deflection Under Load - Maximum vertical deflection under full buoyant or gravity load shall be less than or equal to L/1000, where L is defined as the unsupported trough length in inches. Under no circumstances shall the maximum vertical deflection, measured at mid-point between trough supports, exceed 3/16 inch.

g. Maximum trough side wall horizontal deflection under full lateral load shall be less than or equal to D/100, where D is defined as the trough depth, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16 inch.

h. Trough bottom deflection (oil canning) under full buoyant or gravity load shall be less than or equal to W/100, where W is defined as the trough width, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16 inch.

i. Fiber Stress Limitations - Supplemental to the deflection criteria, the troughs shall also be designed such that the maximum wall stress under the most severe loading conditions is less than or equal to 1500 psi. This stress criterion is equivalent to 7:1 safety factor (approximate) as applied to the tensile and flexural properties of contact molded troughs and launders.

j. Thermal Expansion/Contraction - The troughs shall be designed to accommodate a thermally induced expansion (contraction) of 1/8 inch per 20 feet length of trough over temperature range of 10°F to 100°F, without exceeding the deflection or strain limitations set forth in the preceding sections.

5. Materials:

a. The resin shall be a commercial grade, general purpose polyester thermosetting resin, which has either been evaluated in a laminate, or which has been determined by a previous documented service to be acceptable for the service conditions. The resin shall contain no fillers except as follows:

1) A thixotropic agent, which does not interfere with laminate quality, or with the required chemical resistance of the laminate, may be added for viscosity control.

2) Resin may contain pigments, dyes or colorants, which have been determined by at least five (5) years previous service to be acceptable for the service condition without fading or chalking from original color standard.

b. Ultraviolet Resistance: All laminates have ultraviolet resistance in the form of pigmentation or ultraviolet absorbers.

c. When metal reinforcements are used, they shall be stainless steel and free of rust, oil, and any foreign matter. They shall be completely encapsulated with a minimum of 1/8-inch thick laminate. Cable supports will not be allowed.

d. Glass reinforcements shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter described. Surfacing mat shall be type C, 10-20 mils thick, with a silane finish and a styrene-soluble binder. Chopped strands shall be Type E glass, with silane finish and styrene-soluble binder. The glass content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to Table 1.

6. Manufacture:

a. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Laminations shall be dense and without voids, dry spots, cracks or crazes.

b. The inner surface of the trough shall be reinforced with glass surfacing mat. This shall be followed with chopped strand glass laminate (max. 2 oz. per sq. ft.) in a minimum of two (2) layers. Void content of the complete laminate shall not exceed 2 1/2% of laminate volume.

c. The top edges of the trough shall be level and parallel with a tolerance of plus or minus 1/8 inch (measured when the trough is not loaded).

d. The length of a trough section shall have a tolerance of ± 1/8-inch per 10 feet length.

e. The laminate thickness tolerance shall be plus 1/8 inch minus 0.

f. Thickness at locations of supports such as saddles shall be at least 1-½ times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in the design section of the specification.

g. End flanges and blind ends shall be a minimum of 1 1/2 times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in the design section of this specification.

h. An integrally molded water stop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.

i. One-inch diameter PVC spreaders shall be bolted between the trough walls on approximate 2 feet centers to enhance the structural rigidity of the trough system.

E. Air Scour Grid:

1. The air distribution system shall be generally comprised of a fixed air grid calibrated to evenly distribute air over the entire filter surface area during backwash.
2. All air scour piping shall be Sch. 5, type 304 stainless steel. The anchors and hardware for anchoring the air header shall be type 18-8 stainless steel.
3. Because the proper distribution of air into the underdrain has a significant effect upon operation, the filter manufacturer shall have the responsibility to design and provide the air distribution system for this underdrain.
4. Each lateral shall be fitted with air orifices designed for proper air distribution. Each orifice shall be protected from clogging by media or other material. Plastic nozzles will be unacceptable.
5. Air grid system shall be designed for proper air distribution in an air flow range of 2-5 scfm/sf.
6. The maximum air pressure drop in the air grid shall not exceed 1 psi.
7. The air grid shall be supported from below using anchor rods embedded in the grout, fastened with stainless steel hardware.
8. Provisions shall be made for ease of removal by simply unbolting flanges or braces.

F. Filter Controls:

1. Filter Control Panel:
   a. Provide new Individual Operator Interface Station at each new filter including Filter No. 4.
   b. The operating console shall be constructed of stainless steel. Structural reinforcement shall be provided at the juncture of the console ends and the operating section. Removable rear door shall be provided for access to internal components. Enclosure shall be NEMA 4X.
   c. Panel shall provide the following functions (through the HMI Interface):
      1) Influent Valve Open/Close/Auto Switch (for both influent valves).
      2) Filter Drain Valve Open/Close/Auto Switch.
      3) Filter Effluent Flow Control Valve Open/Close/Auto Switch.
      4) Filter-to Waste Valve Open/Close/Auto Switch.
      5) Air Scour On/Off/Auto Switch.
         a) Turning air switch on will result in blower slowly coming up to full speed in approximately 4 minutes.
      6) Backwash Pump On/Off/Auto Switch.
         a) Turning pump switch on will result in pumped flow slowly coming to preset value over 5 minutes.
      7) Backwash Flow Control Valve On/Off/Auto Switch.
      8) Backwash Filter Isolation Valve On/Off/Auto Switch.
      9) Filter Loss of Head Display.
      10) Filter Effluent Turbidity Display.
      11) Effluent Flow Display, with indication of Filter to Waste or Filtered Water condition.
      12) During normal operation, the following shall be displayed prominently:
         a) Filter effluent flow.
         b) Filter effluent turbidity.
         c) Filter loss of head.
         d) Filter water level.
      13) During backwash, the following shall be displayed prominently:
         a) Backwash water flow and control valve positioner.
         b) Backwash blower speed.
         c) Filter water level.
2. The filter controls shall operate as described in detail in Section 17950 - *Functional Control Descriptions* and 17000 - *Control and System Scope and General Requirements.*

PART 3 – EXECUTION

3.1 PRODUCT HANDLING, STORAGE, AND DELIVERY

A. Place or store underdrains and specialties only in designated staging areas.

B. Store underdrains and specialties off the ground, under ultraviolet-resistant tarps from time of delivery on-site until final installation of the filters.

C. Replace, at no charge to Owner, underdrains and specialties damaged during storage and delivery.

D. Underdrains and specialties are subject to inspection at the Engineer's request if visual evidence of damage is observed.

E. All gravel and filter media will be shipped in "semi-bulk" containers having lifting loops and bottom discharge spout. Anthracite superbags are 60 cubic feet weighing approximately 3,000 pounds each.

F. Delivery of "bulk" shipments will not be permitted unless the contractor can demonstrate that the materials can be handled and stored without contamination.

G. Troughs shall be suitably packaged to avoid damage during handling and shipment. Should it be necessary to store product prior to installation, precautions should be taken to prevent warpage or distortion.

H. Troughs should be stored on a flat place and adequately supported on wooden support members to evenly distribute weight of troughs. When stored more than one (1) high, succeeding items should be stored level and evenly supported by blocks or spacers.

3.2 INSTALLATION

A. Filter Underdrains and Air Scour Grid:

1. The CONTRACTOR shall install the filter underdrain system in strict accordance with: (1) the manufacturer's written instructions and recommendations and the manufacturer's installation drawings; (2) the oral and written directions provided by the manufacturer's technical representative who is supervising and observing the WORK; and (3) any additional requirements specified herein.
2. Floor Preparation:
   a. Care shall be exercised in preparing the filter floor slab and in setting the anchors to assure proper alignment and elevation. Steel anchor rods shall be furnished by the filter manufacturer and set in the floor slab on both sides of the distribution flume. The floor slab shall be screeded into a flat level plane and be free of protrusions and depressions.
   b. Every steel anchor rod shall be pull-out tested prior to block installation.
   c. DO NOT PAINT the floor or wall area where it will come in contact with the grout surrounding the underdrain. The filter floor and filter wall extending fourteen (14) inches up from the filter floor is not to be painted.
3. Underdrain Lateral Installation:
   a. The underdrain laterals shall be set in level rows on a bed of grout over the roughened filter floor slab. Plates for closing the ends of each row of blocks shall be furnished by the filter manufacturer and installed by the Contractor. After joining, aligning and setting the blocks, and the bed grout is set-up, as soon as possible but within 24 hours, all spaces between the rows of blocks and walls shall be filled with grout so that the entire bed is totally sealed and held firmly in place. Once all grouting is complete, the grout shall be allowed to cure for at least 3 full days before any functional testing.
   b. Anchor rods shall be supplied by the underdrain manufacturer and installed by the Contractor. Installation of the anchor rods shall be in accordance with the manufacturer's approved installation drawings and instruction manual.

c. After the anchor rods have been installed and the epoxy has cured, a non-destructive vertical pull test shall be performed. Testing shall be performed on 100% of the anchor rods. The pull test shall be performed by the underdrain manufacturer in accordance with the manufacturer's instruction manual.
   1) Using the test equipment supplied by the underdrain manufacturer, each anchor rod shall be loaded to the vertical tension value and loading increments as specified in the manufacturer's instruction manual.
   2) The specified tension shall be held for 2 minutes.
   3) If an anchor rod fails to reach the specified tension or shows signs of slippage, the tested anchor rod installation shall be rejected. The Contractor shall remove all failed anchor rod(s), install new rod(s), and repeat the test on each new rod. These steps will be repeated until all rods pass the test.
   4) All test results shall be documented and the results for a particular filter shall be approved in writing by the underdrain manufacturer and the Engineer prior to proceeding with installation of the underdrain laterals in that filter.

d. After the laterals have been grouted in place and the grout has cured, random drillings in the grout shall be performed to test for the existence of voids in the grout. Two drillings between each lateral shall be performed at locations chosen by the Engineer. If any voids are found, systematic drilling or other type of grout testing shall be performed to locate all voids. All voids shall be suitably filled in. All drilled holes shall be epoxy filled upon completion of testing.

4. Cleaning and Protection During Installation, Testing, and Startup:
   a. The Contractor shall take all precautions recommended by the underdrain manufacturer or specified herein to ensure that the filter underdrain system and any piping communicating therewith is completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain and air grid system or interfere with flow. Backwash air and water piping shall be thoroughly flushed clean. All loose debris and dirt within the filter cell and flume shall be removed by brooming down and vacuuming. Care shall be taken to keep grout from being deposited anywhere where it could interfere with flow. Any grout so deposited shall be removed. As installation progresses, partially completed portions of the WORK shall be protected with heavy visqueen or other suitable material to maintain the cleanliness of the underdrain system. Such protection shall be maintained until the support gravel is installed.
   b. Any time the underdrain laterals are to be used as a work surface, the underdrain block shall be overlaid with ½ inch minimum plywood sheeting where necessary, to distribute the load of yard buckets, wheel barrows, ladders, scaffolds, etc., to prevent damage to the underdrain.
5. Air Grid:
   a. The air grid shall be installed so that the laterals sit on top of the gravel support media. The exact elevation of this grid will vary by manufacturer. Coordinate the air grid installation as required to achieve the proper elevation in the filter bay.
   b. The air diffusion orifices shall be in a true horizontal alignment on a level plane within ±1/8" over the entire filter area.
   c. Upon completion of the air grid installation, the manufacturer shall provide a certificate of compliance stating that the air scour grid has been installed satisfactorily to the manufacturer.

B. Media:
1. Marks shall be placed on the side of the filter designating the top elevation of each layer.
2. Carefully place each layer so as not to disturb the previous layers.
3. Complete the installation of each layer before the next layer above is started. Do not stand or walk directly upon the filter materials. Workers must stand or walk on boards that will sustain their weight without displacing the gravel and media.
4. Measure depth of each layer of media after it has been backwashed and skimmed as recommended by the filter equipment manufacturer.
5. Clean the filter tanks before any media is placed and keep them clean throughout the placing operation.

6. Filter Sand and Filter Anthracite: Place the filter sand and filter anthracite in the bed in the order of their respective specific gravities. Place and level the filter sand first. Then backwash the bed a minimum of three times, and remove the surface fines by scraping as required to the correct elevation. Place the filter anthracite and backwash the bed three times, and remove the surface fines by scraping as required to the correct elevation.
7. Do not let the bed stay dry more than one day after this initial wetting.

C. Wash Water Troughs:
1. All trough mounting brackets, hardware and stabilizers shall be Type 18-8 stainless steel and shall be supplied by the trough manufacturer.
2. Troughs shall be installed so that the trough weir edges are level to within 1/8 inch.
3. If oscillation occurs during testing, additional supports shall be provided at no expense to the Owner. Cable supports will not be allowed; all additional supports must meet the requirements of this section.

3.3 FIELD TESTING

A. Underdrain Lateral Flow Distribution Test:
1. The filter underdrain system in each filter cell shall be given a series of visual, qualitative, flow distribution tests to verify that orifices are not clogged with debris and that flow distribution is uniform. These tests shall be performed before the filter media is placed.
2. During each test, the underdrain laterals shall be visually inspected for uniform distribution of air and water and for any signs of quiescent zones and excessive surface turbulence.
3. Contractor shall be responsible to ensure that all tests produce results satisfactory to the Engineer.

3.4 MANUFACTURER'S SERVICES

A. Mechanical Filter Equipment Services:
1. The Contractor shall provide the services of the manufacturer's technical representative for not less than eight (8) working days (8 hours per day) to inspect and supervise the installation and testing of the filter underdrain and air scour grid system in at least two (2) trips. Manufacturer's representative shall coordinate with plant staff and contractor to optimize backwashing of the new filter, including adjusting/optimizing air scour feed rate, air scour duration, concurrent air/water feed rates, filter to waste flow rate and duration, as well as backwash water flow rate and duration.
2. Install all items in accordance with the filter equipment manufacturer's recommendations. Upon completion of the installation, the Contractor shall furnish a certificate of compliance detailing that all filter unit equipment and media have been installed in accordance with the manufacturer's instructions and that controls are in place as required for optimal operation.
3. If the manufacturer's representative is not present during portions of work on the filter, the manufacturer will coordinate daily with the Engineer to ensure proper installation.
4. Manufacturer shall provide 16 hours of PLC reprogramming after 6 months of operation. Manufacturer shall ask Owner for suggested improvements to OIT programming at this point.

3.5 DISINFECTION

A. After all work is completed and before the filter is placed in service, the owner will disinfect the entire filter per AWWA C652 and C653.

3.6 TRAINING

A. Manufacturer's field service representative shall instruct Owner's personnel for a minimum of 8 hours at job site on operation and maintenance of filter underdrain, media, air scour grid system and proper filter operation. Included in the training will be a summary of backwash procedures, including a one-page summary sheet of backwash, filter-to-waste, and

return to service procedures. Since backwash training may require the use of process water, coordinate training with WCSA staff during periods of low finished water demand.

END OF SECTION

SECTION 11060

PUMPING EQUIPMENT: BASIC REQUIREMENTS

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - *Painting and Protective Coatings.*
   4. Section 11005 - *Equipment: Basic Requirements.*
   5. Section 11064 - *Pumping Equipment: Submersible Non-clog Sump Pumps.*
   6. Section 11072 - *Pumping Equipment: Vertical Turbine (Line Shaft).*
   7. Section 17000 - *Control and Information System Scope and General 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 where specified to ensure pump and seal compatibility.

C. For variable speed pumping applications, the pump manufacturer shall ensure that the pumps are compatible with the Benshaw VFDs specified in Section 16472.

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.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   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 2.04.
      b. Statement relative to installation and start up per paragraph 3.02-A.4.
   4. Test Reports:
      a. Factory hydrostatic test.

B. Operation and Maintenance Manuals:

1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Mechanical seals:
      a. Chesterton.
      b. Garlock.
      c. John Crane.
      d. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 ACCESSORIES

A. See Section 11005 - *Equipment: Basic Requirements.*

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. Mechanical Seals:
   1. Provide as specified in the narrow-scope pump sections.
   2. 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.

D. 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.

2.3 FABRICATION

A. Pump Support:
   1. Design base to support weight of drive, shafting, and pump.
   2. Comply with HI vibration limitations.
   3. Mount vertical pumps on single piece pedestal baseplate.
   4. Fabricate to withstand all operating loads transmitted from the pump and drive.
   5. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.

B. Non-Clog Centrifugal Pumps:
   1. For all non-clog centrifugal pumps, including self-priming and chopper type pumps provide ½-inch tap with ball valve on cleanout/hand hole for draining prior to opening cleanout/hand hole.

2.4 SOURCE QUALITY CONTROL

A. If specifically required in the individual pump specification sections, provide factory tests:
   1. Adjustable speed units:
      a. Head (FT) verses flow (gpm) pump curves:
         1) Maximum, minimum and two equally spaced intermittent speeds.
         2) Efficiencies along each curve.
         3) Brake horsepower along each curve.
   2. Constant speed units:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along each curve.
   3. Results certified by a registered professional engineer.
   4. Pump manufacturer shall conform with HI Standards.

B. Statically and dynamically balance each pump per HI standards.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 11005 - *Equipment: Basic Requirements.*

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 - Painting and Protective Coatings.
   9. Provide pressure gage on discharge of all pumps.

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 start up 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.
   5. Instruct Owner's personnel for the specified minimum number of hours at job site on operation and maintenance of each of following pumping equipment:
      a. Section 11064 - *Pumping Equipment: Submersible Non-clog Sump Pumps, 4HPS.*
      b. Section 11070 - *Pumping Equipment: Submersible Chopper Type.*
      c. Section 11072 - *Pumping Equipment: Vertical Turbine (Line Shaft), 4 HRS.*
   6. Supervise pump draw down tests to ensure pumps are operating in accordance with the design conditions.

B. Submersible Units:

1. Comply with requirements defined in paragraphs 3.01-B. 7, 8, and 9.

END OF SECTION

SECTION 11064

PUMPING EQUIPMENT: SUBMERSIBLE NON-CLOG SUMP PUMPS

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SECTION 11064

PUMPING EQUIPMENT: SUBMERSIBLE NON-CLOG SUMP PUMPS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sump Pumps in Main Plant Building (P-209 and P-210).
   2. Sump Pump in Energy Recovery Building (P-109 and P-110).

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - *Painting and Protective Coatings.*
   4. Section 11005 - *Equipment: Basic Requirements.*
   5. Section 11060 - *Pumping Equipment: Basic Requirements.*
   6. Section 17000 - *Control and Information System Scope and General Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual.
   2. American National Standard Institute (ANSI).
   3. American Society for Testing and Materials (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
   4. Factory Mutual (FM).
   5. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps (HI).
   6. National Electrical Manufacturer's Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6, Enclosures for Industrial Controls.
   7. National Fire Protection Agency (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc. (UL).

1.3 SUBMITTALS

A. Shop Drawings:
   1. Requirements in Section 11060 - Pumping Equipment: Basic Requirements.
   2. Source quality control test reports.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Submersible non-clog pumps:
      a. Zoeller, Model 151.
      b. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Sump Pumps:
   1. Pump casing: Cast iron, ASTM A48, Class 30.
   2. Motor housing: Cast iron, ASTM A48, Class 30.
   3. Impeller: Cast iron or thermoplastic.
   4. Seal Platte: Cast iron, ASTM A48, Class 30.
   5. Shaft: Stainless steel, ANSI, Series 300 or 400.
   6. Wear ring: Corrosion and wear resistant materials.
   7. O-rings: Buna-N or Nitrile rubber or neoprene.
   8. Bolts and nuts: Stainless steel.
   9. Lower ring seal: Tungsten-carbide.
   10. Upper ring seal: Ceramic or tungsten-carbide and carbon.
   11. Seal metal parts: Stainless steel.
   12. All exposed hardware: Stainless steel.

2.3 EQUIPMENT

A. Performance and Configuration Requirements:
   1. Sump Pumps:
      a. Design condition: 20 gpm at 24' TDH.
      b. Minimum shutoff condition: 0 gpm at 30 FT TDH.
      c. Pump configuration: Submersible.
      d. Maximum pump speed: 3,450.
      e. Maximum nameplate driver horsepower: 1/2 hp.
      f. Drive type: Constant speed.
      g. Minimum solids passage: ½".
      h. Discharge: 1.25".
      i. 120V, single phase.

2.4 ACCESSORIES

A. Float switch assembly:
   1. Stainless steel or PVC float and with stainless steel rod.
   2. Provide adjustable start lead, start lag high alarm, and pump start floats.
   3. Mount switch assembly support to baseplate so switches are minimum 6 IN above baseplate.

B. Provide a duplex pump control panel in a stainless steel or fiberglass NEMA 4X enclosure mounted near the equipment as shown on the drawings.
   1. Control panel shall be UL labeled (with serial number) as an "Industrial Control Panel" assembly.
   2. Motor starters shall be the magnetic, combination type, NEMA rated. IEC rated starters shall not be acceptable. All contractor coils shall be rated 120 VAC. Unless otherwise specified, the control panel shall contain motor starters and controllers for all motors on the equipment controlled.
   3. The control panel shall be designed to monitor and control the pumps based upon the lead, lag, and high level alarm float switches in the sump. High level alarm output shall be provided.
   4. The control panel shall alternate lead and lag pump designation in order to equalize the hours of pumping each pump receives.
   5. Control panel shall be mounted at 4' above main floor level. Provide all required cables for this location. In the plant building this is the Air Scout Pipe gallery floor level of 1798, in the Energy Recovery Building, use the lower floor level.

C. Provide power cable from pump to control panel, suitable for submersible application. Provide each cable with a strain relief and cord grip.

2.5 FABRICATION

A. General:
   1. Provide pumps capable of handling domestic wastewater.
   2. Design pump to allow for removal without entering the wet well.

B. Impeller:
   1. Provide non-clog type dynamically balanced impeller.
   2. Provide wear ring as necessary to assure efficient sealing between volute and impeller.

C. Discharge Connection:
   1. Coordinate with piping layout shown on the Drawings.

D. Shaft:
   1. Design pump shaft of sufficient size to transmit full driver output.

E. Shaft Seal:
   1. Seal shaft with double mechanical type seal running in an oil filled chamber.
   2. The lower seal between the pump and oil chamber shall contain one stationary and one rotating ring.
   3. The upper seal between the oil sump and motor housing shall contain one stationary ceramic or tungsten-carbide ring and one rotating carbon ring.
   4. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
   5. Hold interface in contact by its own spring system.

F. Bearings:
   1. Support shaft on upper and lower permanently lubricated bearings with B-10 life of 15,000 HRS.

G. Motors:
   1. Provide pump with FM or UL listed motor designed for area classification shown on Drawings.
   2. Provide motor of totally submersible design and rated for continuous duty operation in air.
   3. Motors shall be submersible 460 volts, three phase.
   4. Assure motor is capable of running dry for extended periods without damage to motor or seal.

H. Coatings:
   1. To the exterior of the pump casing and motor housing, factory apply polyamidoamine epoxy system equal to or better than System 29 as specified in Section 09905 - *Painting and Protective Coatings*.

2.6 SOURCE QUALITY CONTROL

A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
   1. Check impeller, motor rating and electrical connections for compliance with Specification.
   2. Test motor and cable insulation for moisture content or insulation defects.
   3. Prior to submergence, run pump dry to establish correct rotation and mechanical integrity.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 11060 - Pumping Equipment: Basic Requirements.

B. See Sump Pump Detail on Drawings.

3.2 FIELD QUALITY CONTROL

A. See Section 11060 - Pumping Equipment: Basic Requirements.

END OF SECTION

SECTION 11070

PUMPING EQUIPMENT: SUBMERSIBLE CHOPPER TYPE

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SECTION 11070

PUMPING EQUIPMENT: SUBMERSIBLE CHOPPER TYPE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Chopper Type Pumps: P-104, for mounting in the Middle Fork Raw Water Wet well, upstream of the traveling screen

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements*.
   4. Section 11060 - *Pumping Equipment: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual.
      b. AISI 4140
      c. B16.1, Cast-Iron Pipe Flanges and Flanged fittings, class 25, 125, 250, and 800.
   2. American National Standard Institute (ANSI).
   3. American Society for Testing and Materials (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A108, Steel Bars, Carbon, Cold Finished, Standard Quality.
      c. A276, Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.
      d. A395, Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
      e. A536, Ductile Iron Castings.
   4. Hydraulic Institute Standards (HI).

1.3 SYSTEM DESCRIPTION

A. Provide pump, driver, and accessories through single manufacturer.

B. Provide centrifugal, wet pit proof recirculating chopper pumps and all appurtenances as specified. The pump shall be specifically designed to pump and agitate waste solids at heavy consistencies. Materials shall be macerated and conditioned by the pump as an integral part of the pumping action.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. See Section 11060 - *Pumping Equipment: Basic Requirements.*
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents the following models are acceptable:
   1. Magnetic Centrifugal pumps and accessories:
      a. Pulsafeeder IsoChem Model CMC
      b. Goulds Model 3298

2.2 MATERIALS

A. Standard Materials of Construction:

Component	Material
Casing.....	Ductile cast iron, A536 or A532.
Impeller	Cast Alloy steel, heat treated to 550 BHN, A148 Gr. 90_60.
Shaft	416 Stainless Steel
Mechanical Seal	Alloy 20 welded metal bellows type, with silicon carbide faces or 304 SS metal bellow. Seal with silicon carbide faces and flex mounted stationary seat.
Seal Sleeve.....	316 Stainless Steel
Thrust Bearings	Angular contact double bolt type
Base/Pedestal	Non-Sparking with Bronze slide bracket.
Paint	Alloyed Enamel, NSF-61 Certified.
Guide Rails.....	Stainless steel
Lifting chains and cables.....	Stainless steel

2.3 EQUIPMENT

A. Performance and Configuration Requirements:
   1. P-104
      a. Design condition: 600 gpm at 31 FT TDH with minimum pump efficiency of 55 percent.
      b. Secondary condition: 340 gpm at 42 FT TDH with minimum pump efficiency of 45 percent.
      c. Shutoff condition: 0 gpm at 60 FT TDH.
      d. Pump configuration: Vertical Submersible
      e. Maximum pump speed: 1750 rpm.
      f. Nameplate driver horsepower: 15 HP.
      g. Drive type: Constant.
      h. Drive configuration: Submersible
      i. Suction size 6 IN DIA minimum, discharge size 6 IN DIA minimum.

B. Assure increasing head characteristic from secondary design condition to shutoff condition.

C. Ensure pump will not cavitate under mixing conditions

2.4 ACCESSORIES

A. See Section 11060 - *Pumping Equipment: Basic Requirements.*

B. See Section 11005 - *Equipment: Basic Requirements.*

C. Portable Hoist:
   1. Provide one stainless steel portable hoist with adjustable reach from 24 IN to 36 IN.
      a. Hoist assembly to be rated for 1500 lbs and of suitable height to allow pump to clear access door when open.

b. Provide winch for hoist. Winch is to be suitable for outside installation, equipped with stainless steel chain or cable. Lifting height shall be suitable for tank, or 24 FT, but shall allow pump to clear access doors when open. Access doors will extend at least 2' above the finished floor elevation.

2. Provide stainless steel hoist sockets suitable for installation on existing concrete.
   a. Locate hoist sockets as shown on Drawings.

2.5 COMPONENTS

A. General:
1. Pump casing strength to withstand 150 percent of shutoff head.
2. Pumps must have demonstrated the ability to chop through and pump high concentrations of solids without plugging both in test and field applications.
3. Pumps with fabricated impeller, cutter bar or casing shall not be acceptable.
4. Add-on cutter mechanisms prior to pump inlet shall not be acceptable.
5. Provide volute clean out hand hole.

B. Discharge:
1. ANSI B16.1 Class 125 or 150, LB rated flanged nozzles for discharge.

C. Impeller:
1. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of .010 IN to .015 IN.
2. Impeller shall be cast from ASTM A148 Grade 90_60 alloy and heat treated to 550 Brinell Hardness and dynamically balanced.
3. The impeller shall be keyed to the shaft with a hardened steel bolt with washer, and shall have no axial adjustments and no set screws.

D. Shaft Seal:
1. Provide stuffing box with integral cover.
2. Shall have an alloy 20 welded metal bellows and be fitted with silicon carbide seal faces to provide long life expectancy in the presence of grit and abrasive solids.
3. The seal shall ride on a 316 stainless steel shaft sleeve, with the seal bellows tension set by three (3) set screws.
4. Seals shall be tested for flatness within two (2) Helium light bands under a Helium light source and optical flat.
5. Provide sealing/flushing liquid connection to stuffing box in convenient locations.

E. Shafting and Sleeves:
1. Size shaft to transmit full driver output.
2. The motor/pump shaft shall be one-piece and shall be constructed of 416 stainless steel
3. All Shafting shall have a minimum diameter of 1.5 inches in order to minimize deflection during solids chopping.

F. Bearings, Bearing Housing:
1. Shall be A536 ductile cast iron, and machined with piloted bearing fits for concentricity of all components.
2. Piloted motor mount shall firmly align motor stool on top of bearing housing.
3. Shaft thrust in both directions shall be taken up by either a double-row angular contact ball bearing or by two back-to-back mounted single-row angular contact ball bearings.
4. Overhang from the centerline of the lower thrust bearing to the seal faces shall be a maximum of 1.2 IN, with a mechanical seal to isolate the bearings from the pumped media at operating temperatures to 250°F.
5. Thrust bearings shall be oil bath lubricated by I.S.O. Grade 46 turbine oil, with a minimum B_10 life rated 100,000 hours.

G. Cutter Bar:
   1. Shall be recessed into the pump bowl, with a funnel shaped inlet opening, and shall extend diametrically across entire pump suction opening.
   2. Cutter bar shall be cast from ASTM A148 Grade 90_60 cast alloy steel and heat treated to 550 Brinell Hardness.

H. Casing:
   1. The pump casing shall be of semi-concentric design, with the first half of the circumference being cylindrical beginning after the pump outlet, and the remaining circumference spiraling outward to the flanged centerline discharge.
   2. Casing shall be A536 ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics.
   3. A 1/4 IN NPT pressure tap shall be included in the discharge flange.

I. Motors:
   1. Completely sealed and jacketed vertical solid shaft, normal thrust, submersible, squirrel cage induction type with 1.15 service factor.
   2. 460, 60HZ, 3 PH
   3. Size motor to drive pump continuously over the complete capacity range without the load exceeding the nameplate rating.
   4. Design motor for 40 degrees C ambient.
   5. Comply with Section 11005 - Equipment: Basic Requirements.
   6. The submersible motor shall be UL Listed for Class I, Division 1, Groups C and D explosion-proof hazardous locations as defined by the National Electric Code.
   7. The stator-winding and lead shall be insulated with moisture resistant Class F insulation for continuous duty in 40□ C ambient.
   8. Motor shaft shall be stainless steel; the rotor is to be dynamically balanced to meet NEMA vibration limits; all hardware to be stainless steel.
   9. Automatic reset, normally closed thermal overloads shall be imbedded in the motor windings to provide overheating protection.
   10. No portion of the sewage should be used to cool the motor.

J. Data Plates:
   1. Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.
   2. Provide stainless steel data plate securely attached to pump.
   3. Include manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

K. Power Cable:
   1. Provide power cable from controller to pump suitable for submersible applications in raw water and indicate same by a code or legend permanently embossed on cable.
   2. Size cable in accordance with applicable NEC specifications.
   3. Provide power cable and control cable, length to extend to the cable splice box.
   4. Provide each cable with a strain relief, cord grip, and explosion proof seal installed in accordance with NEC Article 500 to prevent entrance of wet well gases.
   5. Provide a separate conduit for each cable.

L. Temperature Monitor:
   1. Furnish each phase of the motor with a temperature monitor embedded in the motor windings.
   2. Arrange controls so as to shut the pump down and sound alarm should any one of the monitors detect high temperature and automatically with manual reset once the stator temperature returns to normal.
   3. Set temperature of the temperature monitors at 90 percent of insulation temperature rating.

M. Seal Failure Warning System:
   1. Provide an electrical probe for detecting the presence of water in the stator.
   2. If water enters, the probe shall energize electrical circuit to shut down pump and sound alarm circuit for external alarm.
   3. Install the seal failure relay in the pump motor starter as shown on the electrical drawing.

N. Bracket & Rail System:
   1. The pump shall be provided with a guide system to allow easy removal without entering the wet well.
   2. The main base fixture shall be bolted to the floor and shall include a 90 degree cast iron elbow and mounts for two stainless steel rails of standard schedule 40 pipe. The base fixture shall be designed to receive the connecting pump slide bracket without the need for bolts, nuts, or clamps.
   3. The pump discharge will connect to a rail for a design that seals against the base fixture by the weight of the pump.

2.6 SOURCE QUALITY CONTROL

A. All Pumps:
   1. Hydrostatically test volute at 150 percent of shut off head.
      a. Furnish documentation of test.

B. Factory test one pump of each service category:
   1. Measure head (FT) versus flow (gpm).
   2. Furnish characteristic curve and include efficiency and horsepower.
   3. Certify curves by registered professional engineer.

C. Conduct Field Vibration Tests: Assure that vibration limit is less than field vibration limit prescribed by HI. Excessive vibration is considered sufficient cause for rejection of the equipment.

D. Run torsional analysis to assure that shafting is not operating at any destructive critical or half-critical speeds over complete operating range of pumps.

2.7 MAINTENANCE MATERIALS

A. Provide the following spare parts per each pump specified:
   1. Two of each type of O-ring or gasket kits required for routine/preventative maintenance.
   2. One of each type of O-ring or gasket kits required for major pump overhaul/rebuild.
   3. One of each type of retaining ring required for major pump overhaul/rebuild.
   4. One of each type of mechanical seal required for major pump overhaul/rebuild.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. See Section 11060 - *Pumping Equipment: Basic Requirements.*

3.2 FIELD QUALITY CONTROL

A. See Section 11060 - *Pumping Equipment: Basic Requirements.*

END OF SECTION

SECTION 11072

PUMPING EQUIPMENT: VERTICAL TURBINE (SUCTION CAN CONFIGURATION)

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SECTION 11072

PUMPING EQUIPMENT: VERTICAL TURBINE (SUCTION CAN CONFIGURATION)

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vertical turbine pumps for use on chlorinated potable drinking water, which has not been filtered.
      a. Three (3) vertical turbine pumps.
   2. Pumped Material:
      a. Partially settled raw water with chlorine.
      b. Maximum chlorine content: 5 mg/L.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 11060 - *Pump Equipment: Basic Requirements.*
   5. Section 13440 - *Instrumentation for Process Control: General Requirements.*
   6. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

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.
   3. American Society for Testing and Materials (ASTM):
      a. A48, Gray Iron Castings (Class 35 Minimum).
      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. A120, Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.
      e. A276, Specification for Stainless and Heat-Resisting 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. National Sanitation Foundation International (NSF/ANSI).
      a. Standard 61.
   5. Hydraulic Institute (HI).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. See Section 15060.
      d. Acknowledgement that all wetted materials are optimal for use in chlorinated water up to 5 mg/L.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

C. NSF 61 Compliance Certificate.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. See Section 01062 - *Major Equipment Suppliers.*

B. Manufacturers other than those listed here may submit requests for prequalification in accordance with Section 00100 - *Instructions to Bidders* and Section 01062 - *Major Equipment Suppliers.*

2.2 MATERIALS

A. Column: Steel, ASTM A120.

B. Bowl: CI, Class 30.

C. Bowl Bearings: Bronze, ASTM B505, FPM.

D. Pump Shaft: Stainless Steel AISI A582, Grade 416.

E. Pump Impeller: Bronze.

F. Wear Rings: Bronze, ASTM B505.

G. Discharge Head: CI.

2.3 EQUIPMENT

A. Performance Requirements:

1. Booster Pumps P-105, P-106, P-107.
   a. Primary Design Condition: 4170 gpm at 23' TDH and 85% efficiency.
   b. Secondary Design Condition: 6100 gpm at 11.8 TDH and 75% efficiency.
   c. Tertiary Design Condition: 2470 gpm at 30' TDH and 60% minimum efficiency.
   d. Maximum Speed: 1200 rpm.
   e. Drive Type: Variable speed.
   f. Minimum Shutoff Condition: 0 gpm at 40.5 TDH.
   g. Maximum Horsepower: 40 HP.
   h. Column Size: 20 inches.
   i. Suction Flange: 20 inches.
   j. Discharge Flange: 16 inches.
   k. Type of Discharge Head: "T" type with both suction and discharge above grade.
   l. NPSH required. Shall not exceed 22' at any point on the curve.

B. Provide pumps with net positive suction head requirements (NPSHR) less than the net positive suction head available (NPSHA) at all operating conditions.

C. Pumps shall operate without vibration or excessive noise over the full operating range indicated in Pump Schedule.

2.4 COMPONENTS

A. General:

1. Furnish units consisting of a vertical shaft turbine, direct connected to a vertical hollow shaft motor. Design unit with non-reversing ratchets.
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. No individual portion of the pump requiring removal shall exceed a length of 5'.

B. Column:
   1. Construct discharge column pipe of steel and supply with flanged connections.
   2. Provide top sections of column pipes to max length of 37.5".
   3. Provide intermediate column sections not exceeding 10 FT in length.

C. Open Line Shaft:
   1. Carbon steel, rolled and ground.
   2. Maximum section length: 5 FT.
   3. Furnish renewable shaft sleeves constructed from 416 stainless steel at each bearing location.
   4. Undercutting of shafting at sleeve locations is not permitted.
   5. Provide bronze or PTFE bearings at each column connection supported by retainers butted between machined faces of discharge column.

D. Pump Bowl and Suction Bell:
   1. Provide bowl and suction bell constructed of close grained cast iron, free from imperfections and accurately machined and fitted.
   2. Coat pump bowl water passages with an abrasion-resistant baked enamel, phenolic or epoxy.
   3. Provide coating suitable for potable water service.
   4. Design to ensure easy removal of bearings and impeller.
   5. Furnish suction bell with flared end to reduce entrance losses and with a sufficient number of vanes to support lower guide bearings and weight of impeller and pump shaft when dismantling pump.

E. Bearings:
   1. Provide units with sleeve bearings of bronze in each bowl and in suction bell.
   2. In bowl, provide main bronze bearing immediately above impeller and a lower bronze bearing immediately below impeller.
   3. Provide for lubrication of bowl bearings with pumped liquid.

F. Pump Shaft and Impeller:
   1. Provide pump unit shaft constructed of rolled and ground 416 stainless steel.
   2. Furnish enclosed type impellers constructed of bronze and securely attached to impeller shaft.
   3. Ensure impeller is accurately fitted and statically and dynamically balanced to Hydraulic Institute Standards.
   4. Provide bronze replacement wear rings on impellers and in each bowl to prevent wear.

G. Discharge Head Assemblies:
   1. Provide discharge head for above ground mounting constructed of fabricated steel with flanged end discharge outlet located as shown on Drawings.
   2. Provide direction of rotation arrow.
   3. Furnish AWWA 150 lb flanges.
   4. Supply base plate with lifting lugs capable of supporting weight of entire unit.
   5. Provide 3/8" stainless steel tubing from seal flush connection to drain with air gap at drain.

H. 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.

I. Motors:
   1. Inverter duty rated, vertical hollow shaft, squirrel cage, induction type.
   2. 460 V, 60 Hz, 3 Phase.
   3. Size motor to drive pump continuously over the complete head - capacity range without the load exceeding the nameplate rating.

4. Design motor for 35°C ambient temperature.
5. Non-reverse ratchet.
6. Comply with Section 11005.
7. Suitable for operation with an adjustable frequency drive (AFD) over the specified operating range of the pump.

J. Suction Can:

1. The suction can shall be designed to conform to a Type "T" Discharge Head.
2. The suction can shall conform to Hydraulic Institute Standards.
3. The suction can shall be fabricated from AWWA C-200 steel pipe. The outside diameter of the can shall be 42 inches. Internal flow straightening vanes shall be provided as part of the construction of the suction can. A pair of vanes shall be centered to the inlet of the can and extended to the top of the suction can. A set of vanes in the form of a cross shall also be provided under the pump bell. These flow straightening vanes must be designed to provide for 50-100 mm (2.0 - 4.0 in.) clearance to the suction bell. All welds for the suction can shall be full penetration.
4. The suction can shall include a flanged suction piping connection at the location identified on the Drawings.
5. The manufacturer shall furnish all details and instructions for installation of the suction can in the concrete pump pedestal, including requirements for anchor bolts, allowance for grout, and bolts for the discharge head.
6. The suction can shall include a pump sole plate with integral gasket for seal with the discharge assembly.
7. The Contractor and Manufacturer shall coordinate closely and Contractor shall verify the dimensions prior to the finalizing of the equipment order.

2.5 ACCESSORIES

A. See Section 11005 and Division 17.

1. Provide pressure gauges for each pump in accordance with Division 17.
2. Gauge range shall conform to the listing in Pump Schedule.

2.6 FINISHES

A. Provide pumps, motors, and bases with the manufacturer's standard factory-applied paint finish except as noted. Provide coating suitable for potable water service. Tnemec 140 with 6 mils inside and out on the column pipe and interior of the discharge head and exterior of the bowls.

B. Line and coat columns, suction inlets, outside of bowls, and suction can with factory-applied coating approved and optimal for use with chlorinated potable water.

C. Correct damage to lining or coating to Engineer's satisfaction. If necessary, return to manufacturer for recoating.

2.7 MAINTENANCE MATERIALS

A. Extra Materials:

1. Furnish the Owner the following extra parts for each pump service category:
   a. Lower bearing assembly: One set.
   b. Upper bowl bearing: One set.
   c. Line shaft bearing assemblies: One set.
   d. Packing, gland follower, studs, and nuts: One set.
   e. Lantern rings: One.
   f. Wearing rings: One set.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 11005.

B. Install products in accordance with manufacturer's instructions.

C. Check pump and motor alignment according to the Standards of the Hydraulic Institute after complete installation of unit.

D. Apply final paint coat to pump motor and discharge header according to Section 09905.

E. Care shall be taken during the installation of the can to assure concentricity of the pump to the can, and that an out of level condition does not exist for the pump mounting surface. Before installing the pump, the pump mounting surface must be checked to verify that the surface is level within 3mm/mm (0.003 in/in) in all directions and that the pump will be centered in the can (to avoid rotational flow being generated by non-uniform flow around a non-concentric pump).

F. The suction can flange must be supported on all four (4) sides and grouted in place. The suction can flange must also be in conformance with 150# ANSI STD (flat face).

3.2 FIELD QUALITY CONTROL

A. Employ and pay for services of authorized manufacturer's field service representative to:
   1. Inspect equipment to be installed under these Specifications.
   2. Supervise any adjustments, calibrate instruments, and perform modifications as necessary.
   3. Conduct initial start-up 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.
   5. Instruct Owner's personnel for the specified minimum number of hours at job site per Section 01060 on Operation and Maintenance of the Vertical Turbine (Line Shaft) pumping equipment supplied per this specification.

B. Provide Certification of NSF/ANSI Standard 61 approval.

END OF SECTION

SECTION 11152

MIXING EQUIPMENT - SUBMERSIBLE

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SECTION 11152

MIXING EQUIPMENT - SUBMERSIBLE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submersible Direct Drive Mixer:
      a. Middle Fork Wetwell Mixer (M-101).
   2. Equipment furnished under this section shall be mast-mounted submersible 2- or 3-blade type mixer(s). The mixer(s) shall be designed specifically for operation immersed in drinking water and designed to suspend fine particles that have made it past the raw water intake screen with 2 mm openings and 0.25 fps maximum screen velocity.

B. Related Sections include but are not necessarily limited to:
   1. Section 11005 - *Equipment: Basic Requirements.*

C. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA):
      a. L-10 Standards--Standards 9 and 11, Method for Evaluating and Load Rating of Bearings.
   2. American National Standards Institute/American Gear Manufacturers Association (ANSI/AGMA):
      a. 211.02, Standard for Surface Durability of Helical and Herringbone Gear Teeth.
      b. 221.02, Standard for Rating the Strength of Helical and Herringbone Gear Teeth.
      c. 390.03a, Gear Handbook, Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears.
      d. 2000-A88, Gear Classification and Inspection Handbook, Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
      e. 6001-C88, Design and Selection of Components for Enclosed Gear Drives.
      f. 6025-C90, Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives.
   3. American Iron and Steel Institute (AISI).
   4. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Structural Steel.
      b. A48, Gray Iron Castings.
      c. A153, Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.
      d. A307, Low-Carbon Steel Externally and Internally Threaded Standard Fasteners.
   5. American Welding Society Publication (AWS):
      a. D1.0, Code for Welding in Building Construction.
   6. Institute of Electrical and Electronics Engineers (IEEE).
   7. National Electrical Manufacturers Association Standards (NEMA):
      a. MG-1, Motors and Generators.
   8. Occupational Safety and Health Act (OSHA).

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Product technical data:
      a. Provide calculations supporting all shaft, impeller, and gear box design criteria (stresses and critical speed). Calculations to be stamped by a registered Professional Engineer.
      b. Submit all loadings, torques, and forces imposed by operating equipment.
      c. Pumping capacity and water horsepower at delivered power.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

1.3 PROJECT CONDITIONS

A. Exposures:
   a. Possible grit and clay exposure, pH from 6-9

B. Area Weather Conditions:
   1. Operating temperature range: 36-90°F.
   2. Relative humidity range: 20-100 percent.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. See Section 01062 - Major Equipment Suppliers.

2.2 MATERIALS

A. Mixer:
   1. Materials of construction shall be as follows:

Component	Material
Propeller blades	Stainless steel, ASTM A276, Type 316
Propeller hub	Stainless steel, ASTM A276, Type 316
Propeller shaft	Stainless steel, ASTM A276, Type 421
Motor and Gear Housings	Stainless steel, ASTM A276, Type 316
Fasteners	Stainless steel, ASTM A276, Type 316

   2. Mast system:

Component	Material
Mast and all brackets	Stainless steel, ASTM A276, Type 316
Mast bearings	Stainless steel, ASTM A276, Type 316
Fasteners	Stainless steel, ASTM A276, Type 316

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Performance Requirements:
   1. Influent Wet Well Mixer (M-101).
      a. High water level influent wetwell: 1790.
      b. Length of Wet Well: 17 FT.
      c. Width of Wet Well: 17 FT.
      d. Elevation top of wetwell slab: 1792.00
      e. Bottom elevation of wet well: 1770.00
      f. Maximum mixer speed: 3500 rpm.
      g. Motor efficiency: 65 percent.
      h. Maximum horsepower: 4 HP.
      i. Minimum rate of flow: 5200 gpm.
      j. Maximum propeller speed: 400 rpm.
   2. The mixer shall be selected and positioned in the indicated basins to achieve a minimum horizontal liquid velocity of 1 foot per second and/or a uniform concentration of suspended solids in the liquid under the specified operating conditions.

B. Design Requirements:
   1. Each mixer shall be designed for continuous operation submerged in a raw water intake environment. However, the mixer shall also be capable of operation without submergence, in air, for periods of up to two hours. The mixer shall be capable of withstanding, without loss of watertight integrity, submergence in water to depths up to 120 feet.
   2. When in operation each mixer shall be mounted on a mast which, in turn, shall be fixed to the structure. The mast mounting details shall permit adjustment of the direction of

mixer discharge. The entire weight of the mixer and the dynamic loads associated with mixer operation shall be borne by the mast without vibration or distortion of the mast assembly. The design shall permit convenient installation and future removal of the mixer without dewatering the wet well or basin. The manufacturer shall furnish a written warranty attesting to the suitability of the mixer for location and operation.

C. Operating Conditions:

1. Equipment furnished under this section will be required to operate continuously immersed in a tank in a raw water pumping station. The tank is expected to contain a liquid with dispersed organic and inorganic solids.

2.4 EQUIPMENT FEATURES

A. General:

1. The mixer shall be submersible direct drive type that consist of a direct drive motor, propeller assembly, and mast assembly.

B. Drive Unit:

1. General:
   a. The mixer(s) shall be submersible direct drive or gear driven mixer(s) with the motor and propeller being an integral unit. In addition to containing the motor, the drive unit casing shall be designed to be attached to the mast assembly through a bracket mounted on the drive casing. All static and operational loads shall be carried through the drive unit casing and bracket to the mast assembly.
   b. Each mixer shall be of the close-coupled, submersible type design. All components of the mixer, including the motor, shall be capable of continuous underwater operation while the mixer propeller is completely submerged. In addition, all components of the mixer shall be capable of operation in air, completely unsubmerged for two (2) hours.
   c. Major mixer components shall be of 316 stainless steel construction. All exposed hardware shall be of 316 stainless steel. All surfaces coming into contact with mixing liquid other than stainless steel shall be protected by two-part epoxy paint with NSF-61 certification.
2. Motor:
   a. The motor shall be of the squirrel-cage, induction, shell type NEMA B design, housed in an air filled watertight chamber. Stator windings and leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The stator shall be dipped and baked three (3) times in Class F varnish. The motor shall be designed for continuous duty, capable of sustaining ten (10) evenly spaced starts per hour. The rotator bars and short circuit rings shall be constructed of aluminum, the explosion proof variant shall be FM approved for use in NEC Class I, Division I, Group D hazardous locations. Motor shall be inverter duty rated for use with a variable frequency drive.
3. Thermal Protection:
   a. Each phase of the motor shall contain a set of three bi-metallic temperature monitors in the stator windings; one in each phase. The monitors shall be connected in series and coupled to the contractor in the controls panel to provide over temperature shutdown of the motor. The temperature setting shall be 140°C ± 5°C (284°F ± 9°F). The temperature monitors shall automatically reset once the stator temperature returns to normal.

4. Seal Failure Warning System:
   a. An electrical probe shall be provided in the oil chamber for detecting the presence of water in the oil chamber. A solid-state device mounted in the mixer control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber, the probe shall signal the solid state relay in the control panel. The relay shall then energize a warning light on the control panel, or cause the mixer to be shut down. Float switches, dual probes, or any other monitoring devices located in the stator housing are not considered to be early warning system, and shall not be considered equal. The manufacturer shall provide the probe and the relay.
5. Propeller:
   a. The propeller shall be of 316 stainless steel or closed cell polyurethane, self-cleaning backward curved design. Each blade shall be precision cut and welded to the hub. Each propeller is dynamically balanced so its imbalance is less than ISO 1940 G6.3 tolerances preventing excessive vibration or other unsatisfactory characteristics when the mixer is operating.
   b. Propellers shall be slip fit and securely held to the shaft by a stainless steel washer and bolt assembly that is enclosed in a separate hub chamber. The hub chamber is fitted with an O-Ringed cap that seals the entrance of the propeller hub chamber device. The output shaft shall be splined to mate with the matching spline insert of stainless steel that forms the hub of the propeller. The arrangement shall be such that the propeller cannot unscrew or be loosened by torque from either forward or reverse rotation.
6. Cable Entry:
   a. The cable entry shall be an integral part of the upper lid. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by stainless steel sealing washers designed with a close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof, watertight seal at the cable entrance without the need for specific torque requirements. The assembly shall be supported by a shoulder in the upper lid and be evenly compressed by four (4) socket head screws threaded into the upper lid. The connection chamber and motor compartment shall be isolated from each other. Isolation and sealing shall be accomplished through the use of o-rings and compression grommets, providing a water tight seal. Electrical connections between the mixer cable(s) and the motor leads shall be made via a post type terminal board located in the connection chamber or shall be an integral part of the stator casing and composed of a conical cable holder with a flange bearing against a shoulder in the stator-casing opening.
7. Shaft:
   a. The propeller and motor shaft shall be an integral unit. The shaft shall be of 421 stainless steel and designed to resist the maximum forces generated by the mixer. Carbon steel shafts with sleeves are not acceptable. The mixer shaft shall have machined shoulders to permit exact bearing, seal, and propeller placement. The distance between the bearing closest to the propeller and the hub of the propeller shall not exceed 2½ times the shaft diameter.
8. Shaft Seals:
   a. The mixer shall be provided with a double seal system consisting of a mechanical seal on the outer side and a radial shaft seal on the inner side, each working independently of the other. The mechanical seal shall contain both stationary and rotary silicon carbide faced rings. Each mixer shall be equipped with a solids deflection ring to prevent seal failure due to interference from solids contained in the mixed liquid. Only the seal faces of the outer mechanical seal assembly and its retaining clips shall be exposed to the mixed liquid.
   b. The seals shall require neither routine maintenance nor adjustment and shall not be damaged when the mixer is run dry. The seals shall not rely on the mixing liquid as a lubricant.
9. Oil Chamber:
   a. The oil chamber located between the outer and inner seals shall hold a sufficient quantity of oil to provide lubricant and cooling for the shaft seals. The oil shall also act as a sensing medium for the seal monitoring system to detect the presence of moisture.

10. Bearings:
    a. The mixer shall rotate on two (2) permanently lubricated bearings. Bearings shall be of single row, deep grooved design and sized to transfer all radial and axial loads to the mixer housing and minimize shaft deflection for increased bearing and seal life. Bearings shall not require a pre-load and be maintenance free with minimum L-10 bearing life of 100,000 hours at design conditions.
11. Elastometers:
    a. All mating part surfaces of mixer shall be machined and fitted with static BUNA-N O-rings providing watertight sealing. Mating surfaces shall be designed to provide watertight seals when metal to metal contact is made resulting in controlled compression of the O-rings without special torque requirements. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devises shall be used. Any surface in contact with water should be suitable for potable water.
12. Guide Rail System:
    a. A guide rail system shall be used to mount each mixer during operation and to guide the units during installation and removal for service. The system shall consist of a bottom assembly, mixer support assembly, 3-inch by 3-inch (80 mm by 80 mm) guide pipe, upper support and positioning device. The system to be fixed at the bottom of the tank in a pivot which shall allow horizontal rotation of the mast through not less than 120 degrees. All guides and brackets shall be constructed of AISI 316 stainless steel. The mast bearings shall be constructed of Hostaform (POM). Power/control cable holders shall be provided every five feet.
    b. The bottom assembly shall be bolted to the floor of the tank, and provide support for the guide pipe. It shall also include a hole to accept the guide pipe bottom plug. The bottom console and guide pipe shall be constructed of AISI 316Ti stainless steel.
    c. The assembly shall be strong enough to support the weight of the mixer, the guide pipe and the mixer preload force. The assembly shall be positioned in such a manner so as to prevent the mixer blade tips from hitting the basin floor. The mixer support shall be constructed of AISI 316Ti stainless steel.
    d. The upper guide holder assembly shall secure the system to the tank edge or platform. It shall also provide the lateral support for the guide pipe. The assembly shall contain a location to secure the electrical motor cable holder.
    e. Mixer support frame (including angular adjustment brackets) shall be manufactured from: AISI 316Ti Stainless Steel as detailed in the submersible mixer tabulated data listing above.

2.5 CONTROL PANELS

A. Furnish and install control panel(s) for the mixer(s).

B. Controls for Raw Water Wet Well Mixer:
    1. Control panel for the Influent Wet Well Mixer should be installed inside the raw water pump station, next to the mixer access door. The control panel shall be a Nema 4X panel mounted a minimum of 42 IN above the finished floor elevation. The control panel shall have the required control functions and monitoring capabilities as specified herein.
    2. A dry contact shall be provided from the mixer control panel to the main MCC to indicate each alarm status on the mixer.
    3. A dry contact shall be provided from the mixer control panel to the main MCC to indicate each alarm status.

C. Control panel(s) shall accept a single 480V, 3 phase, 3 wire feeder. No other power inputs shall be required or allowed. All controls shall operate at 120 VAC, from a control transformer inside the control panel.

D. Control panel(s) shall be UL labeled (with serial number) as an Industrial Control Panel and assembly. The UL label provided on the enclosure for the enclosure only by the enclosure manufacturer does not meet the labeling requirement on UL label for the completed assembly and wiring.

E. Provide NEMA rated combination type magnetic motor starters for all motors shall be provided in the control panel(s).

F. The manufacturer or supplier of the mixer unit shall furnish the control panel as part of the equipment scope of supply. Control panel submittals shall be included with the submittals of the associated equipment and comply with the electrical specifications for control panel submittal requirements.

G. The control panel shall be designed to monitor and control all required functions of the equipment, including but not necessarily limited to the following:
   1. Automatic operation of the mixer shall be initiated by a timer.
      a. Timer shall be mounted inside the control panel and shall be the 24-hour type adjustable in 5-minute increments.
   2. The mixer motor shall contain temperature monitors in the stator windings. The monitors shall be connected to a contactor in the control panel to provide over temperature shutdown of the motor. The temperature monitor shall send a signal to illuminate the auxiliary alarm light on the face of the control panel when the motor is shut down due to excessive temperature. The temperature monitors shall automatically reset once the stator temperature returns to normal.
   3. An electrical probe shall be provided in the oil chamber for detecting the presence of water in the oil chamber. A solid-state device in the control panel shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber, the probe shall signal the relay and energize the auxiliary alarm light on the control panel door and cause the mixer to be shut down.
   4. As a minimum, the following operating controls shall be provided on the front of the control panel for the unit as required:
      a. Hand/Off/Auto selector switch.
         1) In Hand, the jog push buttons operate the mixer.
         2) In Auto, operation is initiated by the timer, as selected by the operator.
      b. Yellow auxiliary alarm light for thermal sensor.
      c. Yellow auxiliary alarm light for seal failure sensor.
      d. Green run light when mixer is running.
      e. Elapsed and total run time monitors.
      f. Dial type control to set mixer speed through the VFD.
   5. The controls, control panel, and mixer shall be furnished as a complete package. The supplier or manufacturer shall assume responsibility for the integrity, coordination, and detailed design of control system components to provide a functional system as described in the specifications and shown on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with Section 11005 - *Equipment: Basic Requirements*.

B. Vertically and horizontally align mixer rail systems, level and plumb units into position.

3.2 FIELD QUALITY CONTROL

A. Employ and pay for services of authorized manufacturer's field service representative to:
   1. Inspect equipment to be installed under these Specifications.
   2. Supervise any adjustments and perform modifications as necessary.
   3. Conduct start up of equipment. Manufacturer shall provide a one start-up trip.
   4. Instruct Owner's personnel a minimum of 2 hours concerning equipment operation.

END OF SECTION

SECTION 11227

ADSORPTION CLARIFIERS

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SECTION 11227

ADSORPTION CLARIFIERS

PART 1 – GENERAL

1.1 SUMMARY

A. Items included:
   1. Adsorption clarifiers (AC-1, AC-2, AC-3).
   2. Related components as shown on the drawings and as specified herein.
   3. This section of the specification covers the furnishing and installation of Adsorption Clarification components as shown on the drawings and as specified herein.
   4. The following items are a part of this section and shall be furnished by one manufacturer to ensure a properly designed and integrated clarifier system.
      a. Components featuring an up flow Adsorption Clarifier design. The treatment system shall include a complete Adsorption Clarification section, controllers, and the system control panel. An air flush system utilizing existing air blowers and automatic valves for the operation of this system to flush the Adsorption Clarifier. The system is to be constructed in concrete basins, with internal equipment to be fabricated of corrosion-resistant materials, with a minimum of field installation effort. Factory construction of close-tolerance equipment shall be used as much as possible in order to minimize field installation problems. The manufacturer shall supply all components located inside the adsorption clarifier bay. All components exterior to the bay, with the exception of the control panel and related components will be the responsibility of the Contractor.

B. Related Sections include but are not necessarily limited to:
   a. Section 11005 - *Equipment: Basic Requirements*.
   b. Section 17000 - *Control and Information System Scope and General Requirements*.

1.2 QUALITY ASSURANCE

A. Source Control:
   1. All component parts and equipment utilized in the adsorption clarifier system shall be forwarded as a complete integrated system by one manufacturer.
   2. The system must be capable of operating at a range of 50% to 110% of the standard design flow.
   3. In addition to normal start-up service, the systems detailed above shall be fully operational including the demonstration of a fully automated control sequence for the flush of the system, based on reaching design terminal headloss in the clarifier.

B. Qualification:
   1. The manufacturer supplying equipment under this specification shall furnish proof of a minimum of 100 installations and ten (10) years of manufacturing treatment systems as specified.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 for general shop drawing requirements.
   2. Manufacturer's installation instruction.
   3. Manufacturer's statement of proper installation and start up.
   4. The system manufacturer must furnish proof of a minimum of three (3) operating plants that have similar systems treating over 50 NTU raw water for sustained periods of time, and spike loading in excess of 200 NTU.
   5. The system manufacturer shall furnish proof of the system's ability to perform properly while feeding powdered activated carbon at a minimum dosage level of 25 mg/L. This

must be demonstrated by a minimum of three (3) pilot studies and/or operating plants showing positive results.

6. Provide screen shots and description of all proposed HM1 screens for initial review and comment.

B. Operation and Maintenance Manuals:

1. See Section 01340.
2. Shall include a section detailing project specific and operational sequences including manual operation, manual backwash, flow distribution practices, and trouble shooting.
3. Shall be provided in Microsoft Word format.

1.4 SYSTEM DESCRIPTION

A. Adsorption clarifiers specified in this Section shall generally be high rate treatment systems designed and proven to effectively remove coagulated particles from water by means of upward flow through a media bed. General system components shall include:

1. An influent flow distribution system to uniformly disperse influent across the clarifier bottom.
2. Media of sufficient size, depth, and composition to accomplish effective particle removal at required rates and water quality.
3. A system or mechanisms to periodically remove captured solids from the media bed.
4. Necessary values and controls to provide for automated system operations.
5. Related appurtenances, such as media retention devices, effluent, and washwater conveyance troughs.

B. Adsorption Clarifiers furnished under this section shall be installed in 19 FT-3 IN x 16 FT -10 IN x 15 FT SWD concrete tanks.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. See Section 01062 - *Major Equipment and Systems Suppliers.*

B. General:

1. All component parts and equipment utilized in the Adsorption Clarifier system, including the systems described in Section 1.1 shall be furnished as a complete integrated system by one manufacturer. This specification is for a Concrete Adsorption Clarifier Treatment Plant as manufactured by Siemens Water Technologies.
2. furnish and install three (3) identical Adsorption Clarifier modules each capable of 4.66 MGD. The following Adsorption Clarifier treatment system shall be provided:

Number of Basins	Nominal Capacity (MGD)	Total Surface Area (sq. ft.)
3	14	324

3. The Contractor shall install three (3) Adsorption Clarifiers of the dimensions shown on the Drawings providing the total surface area shown in the table above. Clarification shall be accomplished using granular adsorption media specifically manufactured for use in water treatment. The medium shall be designed to optimize the removal of coagulated particles with a minimum of headloss. The clean bed headloss through the Adsorption Clarifier Module shall be less than 18 inches at 10 GPM per square foot. The Adsorption Clarifier Module shall be able to build solids to a headloss of six (6) feet without disruption or movement of the clarifier media.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

A. Water Quality:

1. Clarifiers shall be suitable for treating raw water with the following characteristics:

Parameter	Valve
pH	6-9 standard units
TOC	1mg/L
DOC	1mg/L
Color	< 1 pt. Unit
Alkalinity	60-90 mg/L
Average Turbidity	5 NTU
Maximum Turbidity	60 NTU
Temperature	36°C - 80°C

B. Design Requirements:

1. Design flow (each unit): 3200 gpm
2. Operating Flow Range: 50-110% of design flow
3. Design Loading Rate: 10 gpm/ft^2
4. Surface Area (each): 320 ft^2
5. Maximum Allowable System Head Loss: 6 ft
6. Backwash Volume: 5% of design flow
7. Backwash Rate: 3200 gpm (MAX)
8. Air Requirement: 4 scfm/ft^2

C. Performance Requirements:

1. The clarifier manufacturer shall provide the following process guarantee: "Siemen's Water Technologies guarantees that the adsorption clarifiers furnished for Owner's Middle Fork WTP Upgrade to 12 MGD will remove 90-95% of the applied raw water turbidity from coagulated water of the quality set forth in Section 2.02A of the project specifications, and at a loading rate of 10 gpm/ft^2. Compliance with the requirements of this guarantee provision shall be deemed to have been satisfied when test results for 95% of all hourly samples taken during a seven consecutive day period, satisfy the turbidity removal requirement."

2.3 MATERIALS

A. Media:

1. Clarification shall be accomplished using granular absorption media specifically manufactured for use in water treatment.
2. Media shall be designed to optimize the removal of coagulated particles with a minimum of headloss.
3. The clean bed headless through the adsorption clarifier modules shall be less than 18 inches at 10 GPM per square foot. The adsorption clarifier module shall be able to build solids to a headloss of six (6) feet without disruption or movement of the clarifier media.
4. The adsorption media shall be buoyant with specific gravity of less than 1.0.
5. Buoyant media shall be manufactured of HDPE beads. At least one-half of the beads in the bed shall be rolled to produce an elliptical shape and shall also be scarified to place a groove on the media surface. The rolled and scarified shape provides improved floc retention inside of the clarifier bed. media that does not include the rolled and scarified design is not acceptable.

B. Media Retention System:

1. A media retention screen shall be provided to allow for upflow, restrained operation eliminating any chance of fluidizing the bed during operation. To allow for proper cleaning, the media shall be easily fluidized by the addition of small amounts of diffused air.
2. The adsorption media retainer shall be constructed of a stainless steel mesh screen on an aluminum grating that allows free passage of water, but contains the granular

adsorption media particles. The retainer shall be easily accessible and removable from the top of the adsorption clarifier.

3. The retention assembly shall be easily accessible and removable from the top of the tank.

C. Influent:

1. Influent flow shall be uniformly distributed across the bottom of each clarifier by means of a pipe manifold consisting of a pipe header with pipe laterals. Orifices on the laterals shall be suitably sized and spaced to insure uniform distribution of the influent across the clarifier bottom. The pipe headers and laterals shall be fabricated from 304L stainless steel.
2. Influent flow to each adsorption clarifier shall be controlled by means of an automatically modulated butterfly valve operating off a flow signal from each clarifier influent flow meter.
3. The adsorption clarifiers shall be equipped with an air scour system consisting of a fixed distribution grid with non-clog air diffusers. The air distribution header and laterals shall be constructed of 304L stainless steel.
4. All structural members of the clarifier module will be built from 304L stainless steel or aluminum. Standard flange dimensional connection points shall be provided at the end of the clarifier effluent troughs, clarifier influent distributor, and air scour distributor as shown on the drawings.
5. The air scour system shall consist of a 304L stainless steel manifold with stainless steel lateral pipes. The laterals shall have suitably sized orifices with corrosion-resistant screening devices to prevent entrance of media particles into the air system.
6. A headloss indicator for each clarifier basin shall be provided and be locally mounted below the minimum water level in the clarifier. The pressure tap shall be on the side of the influent line as close to the wall as possible before any fittings or valves in the line. The sensing line shall be equipped with an isolation valve.
7. A bottom drain shall be provided with a stainless steel screened outlet to allow for draining of water without loss of media.

D. Water Collection Trough:

1. Clarifier effluent troughs shall be 24 IN wide by 30 IN deep and shall be 304L stainless steel and positioned as shown on the drawings.
2. The manufacturer shall furnish, for installation by the contractor, the collection troughs in each basin as shown in the drawings. The troughs shall be designed to carry the water flow such that the depth of flow in the trough shall be maintained at least two (2) inches from the top. The collection troughs shall be of stainless steel construction with a minimum thickness of 3/16 inch. The troughs and supports shall be suitably braced and anchored to withstand uplift forces to which the troughs will be subjected shall be sufficient bracing to prevent weir oscillation. The troughs shall be evenly spaced across the clarifier as shown on the plan, and will be supplied to connect by a bolted flange to the concrete walls. Manufacturer to provide all required hardware for trough and connection to concrete walls.

E. Clarifier Valves:

1. All required valves shall be provided by the Contractor. Contractor shall coordinate with manufacturer to provide compatible communication between Contractor-supplied valves and manufacturer's control equipment.

F. Headloss Indicator:

1. A headloss indicator for each clarifier basin shall be provided, to be locally mounted below the minimum water level in the clarifier. The pressure tap shall be on the side of the influent line as close to the wall as possible before any fittings or valves in the line. The sensing line shall be equipped with an isolation valve.

G. Magmeters:

1. Manufacturer shall provide all magmeters required for the AC system. See Division 17 for requirements.

H. Clarifier Controls:

1. AC 1 and 2 shall be provided with a separate PLC driven control panel allowing independent operation of clarifier. AC-3 shall also be provided with a separator PLC-driven control panel allowing operation of AC-3 and providing capability to control the future AC-4.
2. Control panels shall contain all necessary control functions and internal wiring. The controls shall be completely assembled and mounted in a NEMA 4X enclosure. The control panel shall provide automatic starting and stopping of the clarifier, based on a signal from the plant SCADA system.
3. The clarifier control shall provide means for automatically initiating a flush cycle for each adsorption clarifier by a time clock or preset adjustable clarifier headloss pressure switch. An interlock shall be provided so that only one unit can be flushed at a time. A selector switch shall provide override of the automatic flush initiation to allow manual flushing of each unit. During the flush cycle, collected solids shall be removed by proper sequencing of valves of the blower. Return to service shall be automatic. Controls shall allow operator-preset flushing flowrate.
4. Auxiliary contacts or other suitable provisions shall be included in the control panels to transmit the following signals to the plant SCADA system:
   a. Operational status (run, backwash, etc.).
   b. Clarifier influent flow rates and total flow.
   c. Clarifier headloss.
   d. Air scour operator status.
   e. Backwash flowrate and total.
5. The control system shall accept from the Plant SCADA system the plant flowrate and shall automatically distribute flow to the three adsorption clarifiers in the most efficient manner but loading shall not exceed operator preset flowrate, initially set at 6.6 MGD. The control system shall automatically redistribute flow when one clarifier is taken out of service without causing pressure surges or loading any clarifier above the preset flow rate.
6. Flow to the adsorption clarifiers shall be based upon level in the filter influent channel and shall be provided by the booster pump station.
7. Influent flow to the Adsorption Clarifier system shall be regulated by an operator adjustable flow control loop consisting of a flow element (magmeter), transmitter, and PLC program to operate an automatic modulating butterfly valve on each basin influent line.
8. The manufacturer shall provide all required pressure switches with indicator gauge.
9. Manufacturer PLC shall have HM1 interface with control screens as submitted in the shop drawings. Manufacturer will provide two days of additional programming adjustments for 1 year of operation.

PART 3 – EXECUTION

3.1 INSTALLATION

A. The adsorption clarifiers shall be installed as shown on the Contract Drawings and specified herein.

B. The contractor shall retain the services of the Manufacturer to inspect the installation of all equipment in this section prior to start-up in order to verify that the equipment has been properly installed, operates properly as a system and individually, and is properly calibrated. Personnel in the direct pay of the manufacturer shall be onsite for 14 days in three trips, at minimum.

C. After the equipment has been properly installed, the contractor shall retain the services of the clarifier Manufacturer to calibrate the equipment with the Owner's operator present.

D. Equipment supplied by the manufacturer shall not be delivered to the site until installation may properly commence. Materials shall not be stored more than two weeks.

3.2 TRAINING

A. After start-up, the contractor shall retain the services of the Manufacturer to furnish a competent technical service representative to instruct the Owner's personnel in the operation and maintenance of the equipment. Services shall be provided for three consecutive eight (8) hours days, and only time actually spent at the site shall be considered in satisfaction of this requirement.

3.3 PERFORMANCE TESTING

A. Within six (6) months following successful start-up of the adsorption clarifiers, Owner shall determine compliance with the specification section requirement 2.02C, by operating the clarifiers for a seven (7) consecutive day period with raw water characteristics meeting the requirements of section 2.02C. If, after the completion of performance testing, the units satisfy the requirement of section 2.02C, the performance will be determined to be satisfactory. If, after testing, the units fail to meet the performance requirements, the Manufacturer may request a second test by the Owner to establish compliance with the specification requirements. If this test fails to demonstrate compliance with the performance requirements, the Manufacturer shall:

1. Conduct, at Manufacturer's expense, additional tests as needed to demonstrate compliance with this specification.
2. Pay for any and all modifications to the clarifiers that are needed to establish compliance with this specification.

END OF SECTION

SECTION 11240

CHEMICAL METERING PUMPS (PERISTALTIC)

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SECTION 11240

CHEMICAL METERING PUMPS (PERISTALTIC)

PART 1 – GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   2. Hydraulic Institute Standards.
   3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
   4. ISO 9000/2000 standards.

1.2 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Certification Statement per Section 01300 - *Submittals*.
   2. Make, model, weight, and horsepower of each equipment assembly.
   3. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   4. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump.
   5. Detailed mechanical and electrical drawings showing the equipment dimensions, size, location of connections, and weights of associated equipment.
   6. Power and control wiring diagrams, including terminals and numbers.
   7. Complete motor information, including nameplate data, enclosure, and special features.
   8. Factory finish system.
   9. Complete manufacturer's information on Controller.
   10. Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
   11. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
   12. Operation and maintenance manual.
   13. Certification statement that the pump's and tubing's materials of construction are compatible with the product being pumped.

B. Quality Control Submittals:
   1. Factory Functional and Performance Test Reports.
   2. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
   3. Special shipping, storage and protection, and handling instructions.
   4. Manufacturer's printed installation instructions.
   5. Manufacturer's Certificate of Proper Installation.

1.4 EXTRA MATERIALS

A. Furnish for pumps:
   1. One complete set of any special tools.
   2. Two lubrication refills for each pump (for pumps requiring lubricant fluid).
   3. Three spare hoses for each transfer pump.
   4. One calibration column for each pump.

5. Two complete drives of each type used (without panel) suitable for installation in control panel.
6. Two spare pump head assemblies for each type of metering pump.
7. One spare 250-foot length of tubing for each diameter specified.

B. Delivery:
1. In accordance with Section 01600 - *Materials and Equipment.*

PART 2 – PRODUCTS

2.1 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

B. Pump manufacturer must provide pumps, gear reducers, motors, drives, pulsation accumulators and dampeners, leak detection systems and pressure gauges/switches, and other accessories as specified herein, regardless of manufacturer, as a complete integrated package to ensure proper coordination and compatibility. Pumps and variable frequency drives and/or control panels will be rejected if not supplied by the pump manufacturer.

C. The pump and the pump base plate shall be as shown on the Drawings. CONTRACTOR shall be responsible to modify layout of pumps at no additional cost if other pumps are used in the Project.

2.2 ACCEPTABLE MANUFACTURERS

A. See Section 01062 - *Major Equipment Suppliers.*

2.3 EQUIPMENT NUMBERS

A. Refer to attached pump data sheet.

2.4 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.5 MANUFACTURERS

A. Manufacturers of components and accessories specified herein shall be as follows:
1. See Section 01062 - *Major Equipment Suppliers.*

B. To ensure experience, quality control, and product support, manufacturer must meet the following requirements:
1. Must have at least three domestic operating installations of the same size operating in the same service as specified for a period of not less than 2 years.
2. Credit to the OWNER, all unused service person-days specified below, at the manufacturer's published field service rate.
3. Technician must be factory certified and specifically trained on the type of equipment specified. Technician must have a minimum of 3 years direct experience on the size and type of equipment specified. The services of a manufacturer's sales representative will not be accepted to fulfill this requirement.

C. All peristaltic pumps shall be the product of one manufacturer.

2.6 METERING PUMP

A. Positive displacement, peristaltic type pump:
1. Spring loaded head.
2. Dry self-priming capable of running dry without damaging effects to pump or tube.

3. Maximum suction lift capability of 30' vertical water column.
4. Pumped fluid shall be contained within pump tubing and not contact any rotary or metallic components.
5. Shall not require check valves, diaphragms, and dynamic seals in contact with pumped fluid.
6. Capable of operating in either direction without flow variation.

B. Pump head:
1. Consisting of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism.
2. Pump head guard shall be transparent for purpose of viewing direction of rotation.
   a. Pump head assembly:
      1) Pump track geometry shall have a minimum 96.6 mm swept diameter through a minimum track angle of 180 degrees.
      2) Provide high corrosion/impact materials suitable for specified chemical:
         a) Track construction: polyphenylene sulfide (PPS).
         b) Guard construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
         c) Rotor construction: polyphenylene sulfide (PPS).
   b. Tube retainer mechanism:
      1) Provide two spring-loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pump head.
   c. Rotor assembly:
      1) Ensures gradual tube occlusion and compensates for tube tolerance:
         a) Twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution.
            (1) Compressing rollers: 316SS with low friction stainless steel bearings and PTFE seals.
         b) Non-compressing guide rollers constructed of corrosion resistant Nylatron or approved equal.
      2) Clutch: Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution.
      3) Mounting: Axially secure rotor assembly to dogged output shaft of gearmotor via a slotted collet and central retaining screw.
      4) Pump heads shall be capable of tube change without special tools or disassembly.
3. 24-hour continuous duty rated.

C. Tubing:
1. Pump tubing shall be in contact with the inside diameter of the track (housing) through an angle of 180 degrees and be held in place on the suction and discharge by tube retainer clamps.
2. Replaceable without the use of tools and with no disassembly of the pump head.
3. Tubing shall be compatible with specified chemical and have a wall thickness:
   a. 3.2 mm for Series 620.
4. Tubing shall be provided by pump manufacturer.
5. Pump shall readily accept tubing of varying inner diameter without pump adjustment or replacement:
   a. Series 520: 1.6 mm, 3.2 mm, 4.8 mm, 6.4 mm, 8.0 mm, and 12.6 mm ID.
   b. Series 620: 6.4 mm, 9.6 mm, 12.7 mm, and 15.9 mm ID.

D. Drive:
1. Rating: Continuous 24-hour operation, 40°C ambient.

2. 110-120V 50/60 Hz and 220-240V 50/60 Hz, 1-phase field switchable. Supply nine-foot length mains power cord with standard 115V three-prong plug.
3. Max drive power consumption: 135 VA.
4. Enclosure: NEMA 4X.
5. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat.
6. Pumps shall meet the following minimum requirements for operator interface functionality:
    a. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions.
    b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
    c. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
    d. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
    e. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
    f. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 rpm.
7. Auto control features to meet the following minimum functionality requirements:
    a. Remote control inputs.
        1) Speed control:
            a) Primary Analog 420mA or 0-10VDC speed input, with input signal trimmable and speed scaleable over any part of the drive speed range.
            b) Secondary Analog 4-20mA or 0-10VDC scaling input, with input signal trimmable and programmable scaling factor.
            c) Provisions for alternative remote accessory potentiometer (potentiometer shall not be supplied at this time) for primary speed control or secondary speed scaling.
        2) Start/stop control: Via 5V TTL, 24V industrial logic or dry contact. Configurable command sense allowing open to equal run or open to equal stopped.
        3) Forward/reverse control: Via 5V TTL, 24V industrial logic or dry contact.
        4) Auto/manual mode control: Via 5V TTL, 24V industrial logic or dry contact.
        5) Leak detector run/stop control: Via 5V TTL, 24V industrial logic, or dry contact.
    b. Status outputs:
        1) Four relay contacts rated for a 30 VDC with a maximum load of 30W, NO, or NC software configurable to indicate the following:
            a) Running/stopped status.
            b) Forward/reverse status.
            c) Auto/manual status.
            d) General alarm status.
            e) Leak detected status.
        2) Speed output: Analog 4-20mA or 0-10 VDC.
    c. Accepts RS485 data protocol.
    d. Termination: Supply screw-down terminals suitable for up to 18 AWG field wire and accessible through four glanded cable entry points on the pump.
8. Drive motor: Brushless DC motor with integral gearbox and tachometer feedback.
    a. Speed control range of 2200:1 from 0.1 to 220 rpm +/- 0.1 rpm throughout the range.
    b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm.
    c. Circuitry complete with temperature and load compensation and protection.
9. Mounting: Drive shall be self-supporting and shall not require anchoring.
10. Leak detection: Float-type leak sensor mounted to below the pump head for leak detection and pump shut down in the event of a tubing failure.

2.7 CALIBRATION COLUMN

A. Graduated in 0.05-gallon increments, constructed of clear polypropylene and PVC with ball type shutoff valves.

2.8 PULSATION DAMPENERS

A. Pump supplier shall verify whether pulsation dampeners are necessary given the design condition shown in the Drawings and Specifications. If dampeners are required, pump manufacturer shall provide them at no additional cost and CONTRACTOR shall install them in locations noted by pump manufacturer, at no additional costs.

B. Discharge Pulsation Dampeners:
   1. Provide in-line type discharge pulsation dampener, capable of horizontal or vertical mounting.
   2. Dampener shall be constructed of an epoxy-coated Schedule 20 cylinder housing, a hose, and air space surrounding hose. Dampener hose and pump hose shall be constructed of an identical wetted elastomer.
   3. Provide flanged inlet and outlet faced and drilled to ANSI 150-pound standard equal in diameter to the pump discharge port. Wetted flange inserts shall be Type 316 stainless steel or PVC and shall be compatible with the process fluid.
   4. Provide dampener with pressure gauge and air fill valve. CONTRACTOR shall charge dampener with compressed air in accordance with the application requirements as recommended by the manufacturer.

C. Pulsation dampener shall be mounted with 3 feet of the pump discharge port. No other equipment shall be installed between the discharge pulsation dampener and pump.

2.9 FLOW INDICATOR WITH ANALOG OUTPUT FOR METERING PUMPS

A. Provide positive flow indicator with analog output for each metered chemical, as indicated on contract documents.

B. Material shall be PVDF for tube and float.

C. Connections: Female NPT, rated at 150 psi.

D. Clark Solutions. Model DS15 with analog output, or equal.

2.10 STRAINERS

A. Provide strainers on suction side of each metering pump.

B. If two or more pumps are connected to the same chemical tank, one strainer may be used for the common suction header.

C. See Section 15060 for details.

2.11 PUMP MOUNTING STAND

A. Provide stainless steel pump mounting shelf. Shelf shall be minimum 18" deep and as wide as required to adequately hold the pump. Shelf shall be suitable for wall mounting. NSF certified and made of 18 gauge, 316 stainless steel.

2.12 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General:
   1. Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with the requirements of Division 16, Electrical.

2. Unless noted otherwise, motor starters for constant-speed, 480-volt motors shall be provided in a separate motor control center specified in Division 16, Electrical. Provide all necessary control functions to properly interface with this motor starter.

B. Control Panels:

1. Control panel meets UL 508 Standard.
2. Enclosure Construction and Dimension: NEMA 4X, Type 316 stainless steel enclosure, 30-inch height by 24-inch width by 8-inch depth.
3. Drive Type: As called out in attached pump data sheet.
4. Starters and drives as necessary.
5. Cover Features:
   a. Through-door disconnect, lockable.
   b. 3-position selector switch (H-O-R).
   c. 2-position selector switch (Fwd/Rev) manual direction selector.
   d. Flush pushbutton (jog) for use with Fwd/Rev (manual mode only).
   e. Flush Pushbutton: reset.
   f. Manual ten-turn potentiometer for manual speed control (adjustable speed pumps only). No keypad allowed.
   g. Display meter for either flow rate or pump speed.
   h. Elapsed time meter.
   i. Pilot lights with relays for output status and holding alarm circuit as follows:
      1) Run: Red.
      2) Control not in Remote: Green.
      3) Hose Fail: Amber.
      4) High Pressure: Amber.
      5) General Alarm: Amber (drive overload, hose fail, and high pressure).
   j. Inputs/Outputs:
      1) Optically isolated 4 to 20 mA input for speed reference (adjustable speed pumps only).
      2) Drive Ready: Normally closed dry contact.
      3) Alarm: Normall closed dry contact.
      4) H-O-A: Dry contact output when in auto position.
      5) 4 to 20 mA: Isolated output speed reference signal from contact.
      6) Control panel not in remote contact.
      7) Closed loop tachometer feedback.
   k. Voltage: 480V ac, three-phase.

2.13 REVOLUTION COUNTER

A. Provide inductive type sensor to detect rotor revolutions. Mount sensor on the rear of the pump housing.

B. Pump manufacturer to supply sensor only. CONTRACTOR is responsible for any additional equipment that may be required to integrate this into the control system.

C. Inductive sensor actuates a non-maintained NO switch when triggering device passes the sensor. When inductive sensor is powered and pump is in operation, a pulse waveform is generated.

D. Inductive sensor shall be rated to the following maxima:

V_{max} = 30V dc, I_{max} = 150 mA, P_{max} = 4.5 VA

2.14 LEAK DETECTION

A. Provide a float type magnetic reed switch located at the top of the pump to detect leakage of pumped product into the pump housing.

B. Sensor shall be field selected to send normally closed or normally open contact signal to sound a remote alarm, cut motor power, and send signal to SCADA.

C. Pump manufacturer to supply switch only. CONTRACTOR is responsible for alarm and relay to turn pump off.

D. Float switch shall be rated for 50 VA (100VA).

2.15 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with two rows of 1/4 inch die-stamped numbers. The first row of numbers will be the equipment tag number as identified in the Contract Documents. The second number, located below the equipment tag number, will be a Computerized Maintenance Management System number assigned by the OWNER. The equipment identification plate shall be securely mounted in a readily visible location. If attached with wire, wire shall be stainless steel. Equipment tags shall not be attached to handwheels.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. Anchor Bolts: Size by equipment manufacturer, and as specified in Section 05500 - *Metal Fabrications and Castings*.

D. Gauge Connections: Tapped and plugged suction and discharge gauge connections on piping headers adjacent to pumps.

2.16 FACTORY FINISHING

A. Prepare surface and prime coat in accordance with Section 09900 - *Painting and Protective Coatings*.

2.17 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments: Test all equipment actually furnished.

B. Factory Test Report: Include test data sheets.

C. Functional Test: perform manufacturer's standard.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with manufacturer's recommendations and as shown on Drawings.

B. Lubricants: The installation includes oils and lubricants for initial operation for pumps requiring lubrication fluid.

3.2 FIELD TESTS

A. Functional Test: Prior to plant startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test.

B. Performance Test:

1. The CONTRACTOR shall perform field tests on complete pump assemblies to demonstrate their conformance to the Specifications to the satisfaction of the ENGINEER. A test log shall be presented to the ENGINEER upon completion of each test that records flow, as measured by graduated containers or storage volumes.
2. Units apparently failing to meet the Specifications to the satisfaction of the ENGINEER shall be more accurately tested in accordance with Hydraulic Institute Standards. If the pump fails the second test, the unit will be rejected, and the CONTRACTOR shall furnish a unit that will perform as specified at the CONTRACTOR's sole expense.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by OWNER for minimum person-days listed below, travel time excluded:

1. 1 person-days for installation assistance and inspection.

3.4 SUPPLEMENTS

A. The supplement listed below, following "END OF SECTION", is part of this Specification.

1. Pump Data Sheet.

END OF SECTION

PUMP DATA SHEET 11240
CHEMICAL METERING PUMPS (PERISTALTIC)

Chemical and Concentration	No. of Pumps	Tag Nos.	Pump Capacity (gph)	Minimum Speed (rpm)	Maximum Speed (rpm)	Minimum Pressure Rating (psi)	Watson-Marlow Bredel Model	Tubing Bore Size (mm)	Minimum Tubing Wall Thickness	Tubing Material	Max Power (VA)	Voltage	Phase
Sodium Hydroxide 25%	2		1.5 to 15.6	6.3	66	60	520 REM/DUN	9.6	3.2	Marprene	135	110-120 and 220-240	1
Hydrofluosilicic Acid 23%	2		0.9 to 2.3	14	38	30	520 REM/DUN	6.4	2.4	PTFE or Fluorel	135	110-120 and 220-240	1
Sodium Permanganate (20%)	2		0.07 to 3.2	1.2	54	60	520 REM/DUN	4.8	3.2	Marprene	135	110-120 and 220-240	1
Polymer (0.5%)	2		0.38 to 73.5	0.63	116 10 typical	60	520 REM/DUN	12.7	3.2	Marprene	250	110-120 and 220-240	1
Polyaluminum Chloride (100%)	3		3.1 to 81.3	4.7	124 50 typical	60	620 DUN/RE4 Loadsure	12.7	3.2	Marprene	250	110-120 and 220-240	1

Notes:

1. Each chemical shall be provided with a calibration column with a capacity of at least 30 seconds of drawdown at maximum pump output, as shown on the plans.
2. Each pump shall have a revolution counter.
3. Manufacturer shall confirm tubing size and material is compatible with intended chemical.
4. Provide 250 feet of spare tubing for each chemical listed.
5. Maximum pump speeds which include two numbers. The first number is based on a maximum dose required for an unusual circumstance. The second number, followed by "typical", is based on maximum chemical dosing established through bench scale studies.

SECTION 11500

EXHAUST HOOD

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SECTION 11500

EXHAUST HOOD

PART 1 - GENERAL

1.1 SUMMARY

1. This Section includes the following:
   a. Exhaust Hood.
2. See Division 15 Sections for vent piping and ductwork.
3. See Division 16 Sections for electrical services and connections.

1.2 SUBMITTALS

1. Product Data: For each product indicated.

1.3 QUALITY ASSURANCE

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. UL and NEMA Compliance: Provide electrical components required as part of appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

1.4 WARRANTY

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace appliance that fails in materials and workmanship within a five-year period.

PART 2 – PRODUCTS

2.1 APPLIANCE

1. Exhaust Hood: UL listed.
2. Basis-of-Design Product: SND Series Exhaust Only Hood by CaptiveAire.
   a. Width: 48 inches.
   b. Type: Single wall mounted.
   c. Fan Speed: Variable.
   d. Exhaust: Horizontal; 228 cfm/ft.
   e. Color: Polished stainless steel.
   f. Features:
      1) Sloped-front.
      2) For low-ceiling applications.
      3) Double wall insulated front panel

PART 3 – EXECUTION

3.1 EXAMINATION

1. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before installation.
   a. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

1. General: Comply with manufacturer's written instructions.
2. Securely anchor units to supporting structure with manufacturer's standard fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
3. Utilities: Refer to Divisions 15 and 16 for mechanical and electrical requirements.

3.3 ADJUSTING AND CLEANING

1. Test each item to verify proper operation. Make necessary adjustments.
2. Verify that accessories required have been furnished and installed.
3. Remove packing material from and leave units in clean condition, ready for operation.

END OF SECTION

SECTION 11565

INDUCTION GENERATORS

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SECTION 11565

INDUCTION GENERATORS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Provision of two turbine generator sets complete with controls necessary to return all created power back to the plant electrical system.
   a. Equipment enclosures suitable for an indoor environment.
2. Related control equipment and accessories.
3. Required manufacturer services for inspection, repair, and installation assistance for the turbines as required to permit a complete functional installation

B. Related Sections include but not necessarily limited to the following:
1. Section 15103 - *Butterfly Valves.*
2. Section 16150 - *Panel Boards.*
3. Section 15100 - *Valves: Basic Requirements.*
4. Division 17 - Electrical.

C. Contractor shall be responsible to properly install all components of the turbine system. Turbine supplier shall supply all components specified herein and provide all installation assistance required by the contractor. The building, piping, all valves except the turbine inlet valves, and all other incidental appurtenances shall be supplied by the Contractor per the relevant specifications.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. National Electrical Code (NEC).
2. National Electrical Manufacturer's Association (NEMA).
3. Underwriter's Laboratories, Inc. (UL).

B. Installer Requirement: Retain manufacturer's authorized and factory trained representative to assist with the proper installation of units required for this Project.

C. Provide integrated protective relaying to American Electric Power specifications.

1.3 SUBMITTALS

A. See Section 01340.

B. Product Data: Include data on features, components, ratings, and performance.

C. Shop Drawings:
1. Detail equipment assemblies and indicate materials of construction, dimensions, weights, loads, required clearances, and method of field assembly, components, and location and size of each field connection.
2. Provide turbine curves, control strategy description, wiring diagrams, and components cut sheets.

D. Upon satisfactory completion of start up, secure a written statement from turbine manufacturer that the system was installed in accordance with manufacturer's recommendations, properly started up and is ready for operation by the Owner's personnel. Also certify that required operation and maintenance training has been fully satisfied.

E. Operation and Maintenance Manuals:
1. See section 01340.

1.4 WARRANTY

A. Provide a one-year manufacturer's warranty for all new manufacturer supplied products to protect Owner against defects in materials and workmanship. Warranty shall run from the date of startup and include all parts.

1.5 PERFORMANCE GUARANTEE

A. Supplier shall guarantee the installation shall produce power within 75% of the expected system production offered, with adjustments for actual pressure and flow.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Canyon Hydro.

B. Or approved equal.

2.2 TURBINE GENERATOR SETS

A. Provide two turbines one set to run at approximately 3.7 mgd at 102' of head and one set to run at around 6.4 mgd @ 98' of head

B. Turbine Efficiency at design point: 82%.

C. Generator Efficiency at design point: 91%.

D. Generator Speed: 1200 rpm.

E. Output Connections: 480VAC, three phase, four wire.

F. The turbines shall be equipped with hydraulically actuated butterfly valves for introduction of available water. Hydraulic fluid shall be food grade. Provide drip tray and oil absorbent pads for one year of operation.

G. The generators shall be of the induction type, rated 480 VAC, 60 Hz, 3Φ, 37kW and 74 kW.

H. Turbines shall be Cornell Pump Company 10TR2 and 6TR2, or equal.

2.3 SERVICE CONDITIONS

A. Environmental Conditions: Turbine generator set shall be capable of operation under the following environmental conditions: Ambient Temperature: -4 to 50°C.

2.4 MONITORING AND CONTROL

A. Functional Description: Furnish system with ability to remotely start and stop via contacts or serial communication. System or equipment failures shall automatically shut down the turbine generator set and communicate status via contacts.
1. Turbine manufacturer shall install controls for the turbines that provide for one or two turbines to be in operation as follows:
   a. 0-3.7 mgd: No turbines in operations.
   b. 3.7 mgd-6.4 mgd: Smaller turbine in operation.
   c. 6.4 mgd-9.0 mgd: Larger turbine is in operation.

d. 9.0 mgd - 12 mgd: both turbines in operation.
e. The plant flow shall be independent of turbine operation -any additional flow above the high flow specified above is exhausted through the 18-inch pressure sustaining valve to the rapid mix chamber.

2. The controls provided by the turbine manufacturer shall ensure that there is adequate pressure and flow available to run each individual turbine in the above flow scenarios. The only input to the turbine system will be two 4-20mA signals, indicating flowrate and pressure available to the turbines. The turbine manufacturer shall control all operation of the turbines based upon these two signals.
3. The control of the pressure sustaining valve shall be independent of the turbine manufacturer's scope of supply. However, the turbine manufacturer shall only be provided the pressure sustaining valve and pressure relief valves shown on the Drawings and otherwise specified in the contract documents. If additional valving or controls are required these shall be provided by the Turbine Manufacturer.
4. System is to include PLC based auto-restart system following grid failure.
5. PLC to be as required by Electrical specifications, coordinated with contractor.
6. The turbine manufacturer shall provide all equipment required to maximize energy recovery from the South Fork raw water line with pressures and flows as indicated in the table below:

Flow (gpm)	Pressure Head at South Fork Venturi Vault (ft)
830	100
1660	99
2490	98
3320	96
4150	93
4980	91
5810	87
6640	84
8300	75

B. Indicating and Protective Devices and Controls:
1. AC output voltmeter.
2. AC output ammeter.
3. AC output frequency meter.
4. DC bus voltmeter
5. Start-stop controls
6. Overspeed shutdown control.
7. Output over/under voltage shutdown control.
8. Output over/under frequency shutdown control.

C. Manufacturer shall make available software for installation on PC to allow remote data display, setpoint adjustment, incident log retrieval, and control for each system

D. Two 4-20 mA analog inputs shall be provided to the system by the contractor representing:
1. Available water pressure.
2. Available water flow rate.

E. The following outputs shall be provided in 4-20mA signals:
1. Production of each turbine in KW.

2.5 SPARE PARTS AND ACCESSORIES

A. Provide the turbine manufacturer recommended spare parts and all maintenance items required for one year of operation.

PART 3 – EXECUTION

3.1 INSTALLATON

A. Comply with the turbine system manufacturer's written installation and alignment instructions for proper installation; including electrical power connections, control wiring, gas connections, combustion and cooling air circulation requirements, water circuit connections, and service clearances.

B. Vibration Isolation: Shall not be required.

C. Install packaged turbine generator set to provide access, per manufacturer's written instructions, without removing connections or accessories, for periodic maintenance.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

E. Verify that electrical wiring is installed according to manufacturer's submittal and installation requirements in Division 16 Sections. Proceed with equipment startup only after wiring installation is satisfactory.

F. Comply with installation and connection requirements in the related mechanical and electrical sections of this specification.

G. Comply with relevant local building code requirements.

3.2 CONNECTIONS

A. Piping installation requirements are specified in Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment in accordance with NEC requirements.

C. Connect wiring in accordance with NEC requirements.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to assist in testing. Report results in writing. Manufacturer's representative shall be onsite for a minimum of 5 days during the installation and startup period. Manufacturer's will not be brought on site until equipment installation is ready and paralleled with the utility.

B. Perform the following field tests and inspections:
   1. Electrical power and ground check.
   2. Turbine start and full-load power check.
   3. Coordinate tests with tests for transfer switches or other grid-isolation devices and run them concurrently.

C. A written report shall be provided confirming that the manufacturer's commissioning checklist has been completed and any non-conforming installation items have been corrected.

D. Assure that any information required by the manufacturer has been properly submitted to validate the product warranty.

3.4 TRAINING

A. Engage a factory-authorized service representative to provide Owner's representatives with eight (8) hours of on-site instruction in the startup, operation and maintenance of the engine generator and heat recovery equipment. Contractor's installation assistance and travel time to and from the site shall not be considered in the measurement of on-site training time.

END OF SECTION

SECTION 11880

POWDER ACTIVATED CARBON (PAC) DRY CHEMICAL FEEDER

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SECTION 11880

POWDER ACTIVATED CARBON (PAC) DRY CHEMICAL FEEDER

PART 1 — GENERAL

1.1 SUMMARY

A. Section includes:
   1. One (1) complete dry chemical volumetric screw type feeder system capable of feeding and wetting 1.0 cubic foot/hour of Powder Activated Carbon (PAC).
   2. Spare screw capable of feeding at 8.0 ft^3/hr of PAC.
   3. System components include, but are not limited to:
      a. Feeder Mounting Stand.
      b. Solution Tank.
      c. Mixer.
      d. Storage Hoppering.
      e. Bag Feeder.
      f. Dust Collector.
      g. Volumetric Screw-Type Feeder.
      h. Water operated eductor with wetting cone.
      i. Remote mounted controls.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 11040 - *Variable Frequency Drives: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards.
   1. American Bearing Manufacturers Association (ABMA):
      a. L-10 Standards--Standards 9 and 11, Method for Evaluating and Load Rating of Bearings.
   2. American National Standards Institute/American Gear Manufacturers Association (ANSI/AGMA):
      a. 211.02, Standard for Surface Durability of Helical and Herringbone Gear Teeth.
      b. 221.02, Standard for Rating the Strength of Helical and Herringbone Gear Teeth.
      c. 390.03a, Gear Handbook, Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears.
      d. 2000-A88, Gear Classification and Inspection Handbook, Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
      e. 6001-C88, Design and Selection of Components for Enclosed Gear Drives.
      f. 6025-C90, Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives.
   3. American Iron and Steel Institute (AISI).
   4. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Structural Steel.
      b. A48, Gray Iron Castings.
      c. A153, Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.
      d. A307, Low-Carbon Steel Externally and Internally Threaded Standard Fasteners.
   5. American Welding Society Publication (AWS):
      a. D1.0, Code for Welding in Building Construction.
   6. Institute of Electrical and Electronics Engineers (IEEE).
   7. National Electrical Manufacturers Association Standards(NEMA):
      a. MG-1, Motors and Generators.
   8. Occupational Safety and Health Act (OSHA).

B. Qualifications:
1. Manufacturer supplying equipment under this specification shall furnish proof of a minimum of five (5) installations and five (5) years of manufacturing volumetric screw feeders used as powder activated carbon feed systems, as specified.

1.3 DEFINITIONS

A. VFD: Variable Frequency Drive.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Section 11005.
2. Product technical data:
a. Design and performance data
b. Installation instructions
c. Provide calculations supporting design criteria.
d. Submit all loadings, torques, and forces imposed by operating equipment.

B. Operation and Maintenance Manuals:
1. See Section 01340.

PART 2 – PRODUCT

2.1 MANUFACTURERS

A. See Specification Section 01062 - *Major Equipment Suppliers*.

B. Manufacturers shall furnish proof of a minimum of five (5) installations and five (5) years of manufacturing equipment as specified herein.

2.2 FEEDER

A. The dry chemical feeder shall be designed with an inlet hopper assembly, feed screw, gearbox and DC motor mounted on a rectangular fiberglass base. Operating range shall be 20:1 provided by the variable speed drive. This shall be extendable to 60:1 by changing belt position on the 3:1 ratio, 4-step drive pulley. Accuracies of 1 to 2% of full scale shall be achieved when a uniform, free flowing chemical is being fed.
1. The inlet hopper shall have a minimum capacity of 1.6 cu. ft. and shall be constructed of fiberglass reinforced plastic.
a. Vibrating plates in the hopper walls shall be provided for constant agitation of the dry chemical to prevent arching and packing of the chemical through the hopper. These agitation plates shall be driven from an eccentric on the feed screw shaft, which drives a rocker arm that is connected to the vibrating plates in the hopper walls. The plates shall be sealed behind Buna-N covers. The agitator drive shall be easily disconnected if needed by operators.
b. A low level switch shall be mounted in the inlet hopper providing a dry contact for actuating low chemical alarm. The switch shall be FM approval rated for use in Class II, Division 1.
2. The feed screw, discharge spout and hopper bottom trough shall be 304 stainless steel construction. The feed screw shall be 1-1/2". Provide spare feed screw of 2-1/2" .
a. Feed screw, hopper bottom, and discharge spout shall be stainless steel.
b. Feed accuracy shall be ±2% of full scale.
c. Spare feed screw shall be easily installed.
3. The feed screw shall be driven by a 1/4 Hp, 90 VDC, TENV permanent magnet motor with SCR drive. Motor shall have a Class II, Division 1.
a. The motor shall be supplied with a 4-step pulley for adjustment of feed screw speed and capacity.

b. The drive mechanism shall be enclosed to comply with OSHA safety requirements for rotating machinery (OSHA section 1910.212 and .219 Machine Guarding).
c. The DC drive motor shall drive a helical feed screw via a worm and worm wheel speed reduction in a gearbox. The gearbox shall be supplied with a slip clutch to protect the motor.

4. Feeder controls shall be mounted in a NEMA 12 enclosure that is to be remote mounted out of the hazardous area. Power requirements are 120 VAC, 60 Hz, single phase, and 4 amperes. Feeder operation shall be automatic via a 4-20 mA control signal. The control panel shall include the SCR drive, power on/off and feeder remote/local/stop and auto/man control switches as well as a feed rate control, power on-off switch, motor run-stop switch, and feed rate potentiometer. Panel mounted potentiometer calibrated for 0-100% of feeder capacity shall be provided.

2.3 FEEDER MOUNTING STAND AND WETTING CONE EDUCTOR

A. The feeder shall be supplied with a stand designed to support the full weight of feeder and product in the hoppering.
1. Designed to conveniently mount the dry feeder.
2. Support the equipment fully loaded at PAC as shown on Contract Drawings.
3. Bag loader and upper hopper shall be supported by floor as shown on Contract Drawings.
4. 1,000 lb minimum capacity.

B. Wetting Cone Eductor:
1. Feed stand shall provide for feeder delivery into a side mounted wetting cone eductor.
2. Material: Stainless Steel Type 304.
3. Inlet and outlet nozzles with on/off valves. Supply water shall connect directly to cone inlet/outlet.
4. Capacity Maximum: 12 ft^3/hr provided the following conditions:
a. Supply pressure minimum of 40-60 psi.
b. Back pressure maximum of 11.7 psi.
c. Maximum water consumption of 24 gpm.

2.4 HOPPERS

A. A slide gate shall be provided to allow isolation of chemical from the feeder inlet hopper.

B. Provide Flexible Connector constructed of compatible material with all forms of PAC. Locate between slide gate and inlet hopper.

C. A 3' diameter cylindrical converging hopper shall be provided with a 13 cubic foot storage capacity. Hopper shall be constructed of #16 gauge steel.

D. A 3' diameter cylindrical charging hopper, 2' high, shall be provided with a 7.1/ft. cubic foot additional storage capacity. Hopper shall be constructed of #16 gauge steel and shall include a welded support angle. Hopper shall be provided with a split floor plate, made from 3/16" thick steel, to allow floor above to support the hoppering.

E. An adapter plate shall be provided for mounting a bag loader and dust collector. The adapter plate shall be constructed of ¼" thick steel.

F. A bag-loading hopper shall be provided for mounting over the charging hopper. It shall be suitable for handling one 40" bag and shall include a bag spear and a removable screen. Hopper shall be constructed of #16 gauge steel.

G. A Torit Model 75-80 or approved equal dust collector shall be provided for floor mounting. The unit shall have a capacity of 500 CFM @ 3.5" static water pressure, 150 square feet of fabric filter area, and a manual shaker. Motor shall be a maximum of 1 HP, 230/460 V, 3 Ph, 60 Hz, 3600 RPM, explosion proof.

2.5 ADDITIONAL APPURTENANCES

A. Bindicator low level bin switch, FM approved Model R rotary type, side mounted, explosion proof, shall be provided.

B. Bindicator FM Approved Model R high level bin switch, rotary type, side mounted, explosion proof, shall be provided.

C. Pneumatic vibrator shall be provided with an explosion proof solenoid valve.

PART 3 – EXECUTION

3.1 INSTALLATION

A. The equipment shall be installed per the contract documents and manufacturer's recommendations.

B. Lubricants and oils shall be included for initial operation of the feeder.

3.2 FINISHING

A. Factory coat and prime per Section 09905.

3.3 FIELD TEST

A. Functional Test: Prior to plant startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by OWNER for minimum person-days listed below, travel time excluded:

1. 1 person-days for installation assistance and inspection.
2. 1 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. 1 person-days per session for prestartup classroom or site training.

3.5 WARRANTY

A. The equipment/system warranty shall be one year from start-up.

END OF SECTION

SECTION 11921

CHEMICAL FEED: CHLORINE

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SECTION 11921

CHEMICAL FEED: CHLORINE

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:
   1. Chlorine gas feed system.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 16 - Electrical.
   4. Section 11005 - *Equipment: Basic Requirements.*
   5. Section 11920 - *Chemical Feed: Basic Requirements.*
   6. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   7. Section 17000 - *Control and Information System Scope and General Requirements.*

1.2 QUALITY ASSURANCE

A. See Section 11920 - *Chemical Feed: Basic Requirements.*

B. Referenced Standards:
   1. Chlorine Institute Incorporated:
      a. Pamphlet No. 1 - Chlorine Manual.
      b. Pamphlet No. 6 - Piping Systems for Dry Chlorine.
      c. Pamphlet No. 8 - Chlorine Packaging Manual.
      d. MSDS - Chlorine.
   2. American Society of Mechanical Engineer (ASME).

1.3 SYSTEM DESCRIPTION

A. General:
   1. Provide single source coordination responsibility through the gas feed equipment manufacturer for the entire chlorine system.

B. Chlorine System:
   1. Chlorination system that will use chlorine supplied in one-ton chlorine containers and in which chlorine is handled completely under a vacuum from the containers through the metering feeder to the injector where it becomes a dilute chlorine solution for introduction into the process fluid.
   2. Automatic (flow proportional) control of chlorinator feed rate.
   3. Special services for the chlorination system as a whole including diagrams and training furnished by the chlorinator manufacturer.

C. Gas Leak Detectors:
   1. Chlorine gas leak detector to be installed to alarm at pre-set room gas concentrations and signal operation of exhaust air ventilation equipment.
   2. Chlorine dioxide gas leak detector to be installed to alarm at pre-set room gas concentrations and signal operation of exhaust air ventilation equipment.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*

B. Operation and Maintenance Manuals:

1. See Section 01340 - *Shop Drawings, Product Data and Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Gas feed equipment:
      a. Superior.
      b. Regal Systems International, Incorporated.
      c. Or approved equal.

B. Submit requests for substitution in accordance with Specification Section 01640 - *Product Substitutions.*

2.2 MATERIALS

A. Assure all components utilized in the system are fully compatible with chemicals with which they will contact.

B. Piping: See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

2.3 CHLORINE FEED SYSTEM

A. Vacuum Regulators:
   1. Capacity: 500 pounds per day each.
   2. Number: Eight (8).
   3. Provide pressure check and standby pressure relief.
   4. Provide gas strainer with replaceable filter.
   5. Yoke mount directly onto the one-ton cylinder gas withdrawal value employing a non-reuseable lead gasket.
   6. Reduce gas pressure at one-ton container to optimum amount of vacuum for chlorination system.
   7. Moderate opening to maintain required flow of gas.
   8. Close automatically if operating pressure fails.
   9. Allow on-line supply to completely exhaust.

B. Vacuum Manifold:
   1. Provide connections to each vacuum regulator on all eight cylinders.
   2. Provide manifold system which ensures gas flow through each cylinder is exactly the same regardless of temperature or pressure differences.

C. Remote Vacuum Switchover Valve:
   1. Capacity: 4000 pounds per day.
   2. When the operating container supply manifold is nearly exhausted, the resulting increased vacuum shall cause the alternate container supply manifold to come online. Both systems shall be online until one is completely exhausted.
   3. Manual shut-off feature to permit container change without interrupting the feeding operation and to avoid entry of foreign matter.
   4. Provide relay output for status indication. Provide 24/120 VAC supply.
   5. Include remote status contact to indicate switchover.

D. Chlorine Storage Equipment:
   1. Scales for Ton Containers: Provide scales and remote indicators for weighing one-ton containers of chlorine as shown on the Drawing. The scales shall be "Chlor-Scale" model DR 40 and the indicators shall be Wizard 4000-4 as manufactured by Force Flow Equipment Company; or equal.

a. The scale shall be of the digital readout/electronic load cell type including floor-mounted frame, load cell, roller trunnions, and load binder straps. The scale shall be of the single load cell design and have the capacity to weigh one 1-ton chlorine container. There shall be one load cell per scale.
b. Scale frame shall have a 2-part epoxy finish and be sized to accept one-ton chlorine container. The frame shall have the required number of heavy-duty roller trunnions installed for each container to allow easy container rotation. The scale frame shall be of such a size that it is within the dimensions of the container it supports. The height of the scale frame shall be such that the top of the container is no more than 40 inches above the top of the container support pad.
c. Weight shall be transferred via lever(s) to a single load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. The cable length shall be 20 feet.
d. Each indicator shall independently monitor and display the tare weights of four scales as shown on the Drawings. The indicator shall have a 20-key digital keypad, and ability to display 2 scales at a time on a backlit alphanumeric display, and automatically scan all scales in the system. Full-scale accuracy shall be better than 1/4 of 1%.
e. The indicator shall have adjustable 4-20mA signals that output tare weight for each scale. The indicator shall display an alarm in any of the following conditions: low level, high level, low feed rate, high feed rate, maximum daily use, minimum daily use, supply exhausted and load cell failure. An alarm log shall store the most recent 10 alarm conditions with time and date of occurrence. Power to the indicator shall be 120VAC, single phase.
f. The indicator shall display net remaining, pure chemical remaining, feed rate, daily usage, total amount used, days until empty, gross weight and tare weight. A data log shall store the daily usage for each of the previous 31 days. Indicator re-calibration in the filed shall be accomplished through the keypad and shall not require the use of dead weights.
g. The indicator shall be housed in a NEMA 4X, UL approved enclosure.
h. Provide two sets of 5,000-pound test load binder straps to anchor each chlorine cylinder onto the scale and prevent lateral movement. Straps shall be nylon web tie-down assemblies with adjustable ratchet buckle at open ends and eyes at ends fixed to the scales.

E. Trunnions: Provide two trunnions and two straps for each one-ton chlorine container position per Contract Documents.
1. Trunnions shall be roller type with solid UHMW polyethylene rollers on stainless steel axles mounted on a base of 1/2-inch plate steel, powder polyester plastic coated.
2. Each trunnion shall be furnished with two sets of 5,00-pound test binder strap with ratchet buckles to restrain a container from rolling off the trunnions lateral (two straps per cylinder). Straps shall be load hugger type as manufactured by Lift All Products Company; Liftex Slings, Inc.; or equal.
3. Manufacturer: Scaletron Industries, Model 3000ST; or equal, with straps as specified.

F. Chlorinators:
1. Provide six wall mounted, differential or sonic flow control units.
2. Capacity: 500 pounds per day.
3. Turndown shall be 20:1, and the unit shall operate at 10-50" of water vacuum.
4. Control Unit: All vacuum differential operation unitized module. A pressure relief device shall not be required at the control unit.
5. Furnish spare rotameter.
6. Feed Range: 20 to 1 in manual operation, and 10 to 1 range in automatic operation.
7. Gas differential or sonic vacuum regulating device to maintain the set feed rate within 4% of indicated gas flow.
8. Gas flow indicated on a rotameter with scale at least 10 inches long marked in pounds per day units.
9. Controls with accuracy of 2%, sensitivity of 0.2%, and repeatability of 1% of full scale.
10. Speed of Response to a Change of Input Signal: within 30 seconds.

11. Dosage Control: Adjustable from 0 to 200% of flow input signal.
12. Input Signals: Unit shall be controlled through the control mode noted in Contract Documents.
13. Vacuum Switch in the Cabinet: Provide dual switches in one box to close contacts on abnormal vacuum, either high, low, or both. High vacuum shall denote loss of chlorine and low vacuum shall denote loss of injector water-generated operating vacuum. Suitable for 120-volt AC power.
14. Operate on 120 volts AC single phase power and provide a power "ON" lamp and disconnect switch.
15. Manual/automatic control shall be microprocessor based.
16. The feed rate actuator shall have a reversible electric motor with thermal overload protection, a manual override, continuous indication of gas feed rate controlling position, limit switches, and feed back circuit to the controller.
17. Nameplates describing function/units of each switch and display device.
18. Factory pre-wire with coded terminal strips for wiring connections.
19. Output signal: Unit shall provide 4-20 mA output to plant SCADA system indicating chlorine output.

G. Injectors:
1. Capacity to suite the maximum installed capacity of each chlorinator rotameter. Provide extra throat, tailpiece, and other replacement parts to match the capacity of spare rotameters specified with the chlorinator.
   a. Provide a 1-inch fixed throat injector to control water flow on feed systems with capacity of 500 pounds per day feed rate.
2. Injectors shall have a body of PVC construction with a pressure rating of at least 175 psi.
3. spring-diaphragm valve, ball check, and drain relief features to protect against backflooding and a 1/4-inch drain tube.
4. Gas inlet connection.
5. Mounting bracket.
6. Injector shall dilute the gas with water to produce a chlorine solution no stronger than 3,500 parts of chlorine per million parts of water.
7. Injector shall provide the necessary vacuum to feed the maximum capacity of the specified rotameter using no more than 20-gpm water at 100 psi pressure when operating against a backpressure of 15 psi. The Contractor shall modify piping as necessary to meet water demands of second named or substitute equipment and/or modify the injector.
8. Water supply to each injector shall have solenoid valve which shall open upon call to start chlorinator.

H. Chlorine Gas Leak Detector:
1. Provide gas leak detector to continuously monitor the atmosphere and sense chlorine gas at a preset OSHA level of one (1) part of chlorine per one million parts of contaminated air by volume.
   a. Provide two sensor or sampler units for replacement and installation in the chlorine storage room and chlorinator room remote from the control unit with required connection in between.
   b. Operate on 120-volt AC single-phase power.
   c. Power "ON" lamp.
   d. Disconnect switch.
   e. NEMA 4X enclosure.
   f. Indicate an alarm condition by a local lamp.
   g. Provide three dry contacts rated at 10 amps, which can be wired, normal open or normal closed to provide remote alarm and control functions.
   h. "Test" and "Reset" circuitry.
   i. Suitable for use in the presence of chlorine and Factory Mutual approved.
   j. Wall mounted control unit.
   k. Provide a test kit that can be used to check the leak detector for proper operation.
   l. Provide battery backup.
2. Provide MSA Ultima X Monitor, or equal.

2.4 ACCESSORIES

A. Piping:
   1. See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   2. Chlorine Gas Piping: For chlorine vent relief lines and chlorine under vacuum service:
      a. Tubing: Polytetrafluoro ethylene (PTFE), 1/16-inch wall flexible tubing with PVC tube connector fittings.
      b. Piping: PVC Schedule 80 pipe and fittings, ASTM D1784, D1785, and D2467 solvent weld socket joints except threaded with Teflon tape joints connecting to threaded equipment. Three wrap minimum.
      c. Valves: PVC with PTFE trim rate for vacuum service.
   3. Smoke Candles:
      a. Furnish non-explosive smoke candles that produce one minute of non-toxic smoke which leaves no residue, for use in checking for leaks in chlorine Storage Room.
      b. Manufacturer: E.V. Hill Inc.; Safe-Vue Candles; or equal.
   4. Flexible Connections:
      a. Cylinder connections:
         1) 5/8 IN OD x 4 FT.
         2) Quantity: Eight (8).
      b. Vacuum regulator vent:
         1) 1/2 IN OD x 4 FT.
         2) Quantity: Eight (8).

B. Valves:
   1. Chlorine:
      a. General:
         1) Valve materials and construction to conform to Chlorine Institute Specifications.

C. Solution Equipment:
   1. Main connections:
      a. Pipe Tap Type:
         1) Pipe NPT. Size 1 IN DIA.
         2) Provide solution isolation PVC ball and solution check valve.
         3) Provide PVC flange set or adapter for hose connection.
      b. Channel diffusers:
         1) See diffuser schedule in Drawings.
         2) Diffusers to be made of Schedule 80 PVC.
         3) Quantity: One (1).
      c. Acid Feed:
         1) Refer to Section 11262 - *Chlorine Dioxide Generation System (Liquid).*

D. Miscellaneous Equipment and Spare Parts:
   1. Furnish following miscellaneous equipment and spare parts:
      a. 1 EA-Tools or wrenches for connecting or disconnecting containers and adjusting any operating equipment.
      b. 6 EA - Expendable filter replacement cartridges.
      c. 6 EA - Expendable gaskets or washers for containers.
   2. Furnish the following Preventative Maintenance Kits:
      a. Vacuum regulators.
      b. Remote vacuum switchover value.
      c. Chlorinators.

E. Enclosures:
   1. Provide NEMA 4X, except as noted.
   2. Provide gas tight terminal boxes with threaded hubs for conduit connections.

PART 3 – EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Install equipment in accordance with manufacturer's recommendations and ANSI K61.1 criteria as applicable.

C. Manifold vent lines as shown in Contract Documents and route to outside of building away from doors and commonly used walkways. Provide screen at the vent discharge.

D. Install all of the components of the complete chlorine system as a system.

E. Keep all components clean and dry.

F. Adequately support and anchor the components to the structure with corrosion resistant fasteners.

G. Install equipment plumb and level. Attach wall-mounted devices with appropriate corrosion-resistant fasteners.

H. Locate sensor of chlorine and chlorine dioxide leak detector 12 inches above the floor.

3.2 FIELD QUALITY CONTROL

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Cleaning and Testing of Piping:
   1. Clean and test all chlorine piping and equipment in the following sequence. Points of connection shall be temporarily plugged or capped to exclude moisture and foreign matter prior to being connected.
   2. Cleaning:
      a. Chlorine Gas Piping: After erection, blow out with dry nitrogen at a rate that will result in a dry nitrogen velocity of 5 feet/second until there is no evidence of dust, dirt, or debris.
      b. chlorine solution Piping: After erection, flush with clear water until there is no evidence of dust, dirt, or debris.
   3. Testing:
      a. Test all PVC chlorine solution piping with clean water at 150 psig for four hours with no loss in pressure.
      b. Test the chlorine vacuum piping at 15 inches Hg absolute pressure for four hours with no indication of leakage.
      c. Test chlorine gas piping under a vacuum of 0.2-inch Hg absolute held for 12 hours with no rise in pressure to demonstrate tightness and dryness.
      d. Remove any devices, instruments, or equipment that may be damaged by the test pressure (negative or positive).
      e. Install all additional valves, test nipples, etc., necessary for a practical testing procedure.
      f. Supply all equipment, gases, instruments, etc., required for the above specified testing.
      g. Supply for all additions to piping systems to accomplish the cleaning, testing, and dehydration.

C. Testing Rooms for Gas Tightness:
   1. It is intended that in the event of a leak that the chlorine be confined to the Chlorine Storage Room up to the pressure for which the building has been designed.
   2. Smoke test the room where chlorine will be stored and make gas-tight.
   3. Set off smoke candle and perform the smoke test to detect leaks which chlorine could penetrate.

4. Reseal and caulk all conduits, pipe opening spaces, cracks, or other leaks and repeat as necessary to demonstrate that the space is gas-tight above, below, and adjacent to the Chlorine Storage Room.

D. Field Services:

1. Provide minimum of four (4) man-day of onsite services by the manufacturer's factory trained engineer or technician after the work is installed, cleaned, and tested.
2. Include the following services:
   a. On-the-job training for operations and maintenance personnel of the Owner.
   b. Safety inspections and instruction.
   c. Preventative maintenance instruction.
   d. Assistance with cleaning and/or tune-up.
   e. Calibration check and recalibration of instruments.
   f. Shut-down instructions.
   g. Startup and commissioning instructions.

3.3 DEMONSTRATION

A. The system supplier shall be responsible for the testing and startup of the system, including pressure testing, adjusting, calibration, and operation of all local and remote components and instruments of the system.

B. Demonstrate proper functioning of the operating system in all modes to the Engineer.

C. Demonstrate operation over the entire range and all controls and alarm conditions.

3.4 CHLORINATION EQUIPMENT SCHEDULE

Feed Locations	Chlorinator Type	Tag No.	Maximum Design Capacity (lbs/day)	Anticipated Operating Capacity (lbs/day)	Control Mode	Measurement Range (mg/L Cl_2)	Cl_2 Feed System
AC/Filters	Wall Mounted		500	100	Flow Proportional	0-20	Injector
Flocculator #2 or Rapid Mix	Wall Mounted		500	100	Flow Proportional	0-20	Injector
Spare	Wall Mounted		500	--	Flow Proportional	0-20	Injector
CCT or Rapid Mix	Wall Mounted		500	500	Flow Proportional	0-20	Injector
CCT or Rapid Mix	Wall Mounted		500	--	Flow Proportional	0-20	Injector
CCT or Rapid Mix	Wall Mounted		500	--	Flow Proportional	0-20	Injector

END OF SECTION

SECTION 11924

CHEMICAL FEED: HYDROFLUORILICIC ACID, POLYMER, SODIUM PERMANGANATE, SODIUM CHLORITE, AND OTHER CHEMICALS

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SECTION 11924

CHEMICAL FEED: HYDROFLUORILICIC ACID, POLYMER, SODIUM PERMANGANATE, SODIUM CHLORITE, AND OTHER CHEMICALS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Scales for Hydrofluorilic Acid and Sodium Permanganate.
2. Polymer feed equipment.
3. Miscellaneous equipment for Hydrofluorilic Acid Room.
4. Miscellaneous appurtenances for Hydrofluorilicic Acid, Polymer, and Sodium Permanganate.

B. Related Sections Include:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 11005 - *Equipment: Basic Requirements.*
4. Section 11060 - *Pumping Equipment: Basic Requirements.*
5. Section 11240 - *Chemical Transfer and Metering Pumps (Peristaltic).*
6. Section 11921 - *Chemical Feed: Chlorine.*
7. Division 16 - Electrical.

1.2 QUALITY ASSURANCE

A. See Section 11920 - *Chemical Feed: Basic Requirements.*

B. Section 17000 - *Control and Information System Scope and General Requirements.*

C. Referenced Standards:
1. NSF-61.

1.3 SYSTEM DESCRIPTION

A. General:
1. Provide complete chemical system to ensure no leaks in delivery from day tank to process input.
2. Install equipment according to plans and specifications and allowing access for maintenance and repairs.
3. Provide a minimum of a 30-day supply of NSF approved chemicals.

B. Scales System:
1. Provide scale for hydrofluorosilicic acid and sodium permanganate.
2. Provide two (2) weight indicators; one for one for hydrofluorosilicic acid scale and one for sodium permanganate scale.

C. Polymer Feed System:
1. Provide two (2) dry polymer polyductor systems, each capable of disposing and directing up to 50 pounds per day of dry polymer into 0.5% polymer solutions.

D. Hydrofluosilicic Acid System:
1. Provide protective safety gear for handling fluoride chemicals.

E. Miscellaneous Appurtenances:
1. Provide for sodium permanganate tubing.
2. Provide y-strainers on the suction line of every day tank dry mixing tanker PAC equipment.

3. Provide backflow precautions on solutions, water pipelines, and suction side of the following pumped chemicals:
    a. Polymer.
    b. Sodium Permanganate.
    c. Sodium Hydroxide.
    d. Polyaluminum Chloride.
4. Provide valves and piping compatible with chemical and chemical solution.

1.4 SUMITTALS

A. Shop Drawings:
1. See Section 11005 - *Equipment: Basic Requirements.*
2. Provide cut sheets showing scale compatibility with respective dry tank.

B. Operation and Maintenance Manuals:
1. See Section 01340 - *Shop Drawings, Product Data, and Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

C. Certification of chemical compatibility with material used.

D. MSDS and NSF approval of chemicals supplied.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Scale Systems:
    a. Force flow.
    b. Or approved equal.
2. Polymer Feed System:
    a. Excell Feeders, Inc., Model #7010-C-100.
    b. Or approved equal.
3. Hydrofluosilicic Protective Safety Gear:
    a. Dupont.
    b. Or approved equal.
4. Miscellaneous Appurtenances:
    a. Strainers, backflow prevention devices, valves, and piping - as specified in Contract Documents.
    b. Stingers - E&S Technologies, Inc. or approved equal.

2.2 MATERIALS

A. Assure all components utilized in the system are fully compatible with chemicals with which they will contact.

B. Piping: See Section 15060 - *Pipe and Fittings: Basic Requirements.*

C. Valves: See Section 15010 - *Mechanical: Basic Requirements.*

2.3 SYSTEM

A. Scales:
1. Capacity: 2,000 lbs.
2. Number: Two (2).
3. Dimensions: 40-inch by 40-inch.
4. Weight Indicator:
    a. Quantity: Two (2).
    b. Four separate channels.

c. Adjustable 4-20 mA signal.
d. Wizard 4000 by Force Flow or approved equal.

5. Provide all electrical cables with compatible covers for respective chemical environment.

B. Polymer Feed:

1. DC motor operated disc feeder:
   a. DC motor with variable speed control.
2. Minimum feed rate: 0.1 to 1 lbs/min.:
   a. Easily changeable.
3. Hopper:
   a. Minimum capacity: 136 lbs.
   b. Vibrator: minimizes bridging.
   c. Non-stick surfaces compatible with chemical.
4. Frame, Sides, Hinges:
   a. Stainless steel.
   b. Clear front latched panel.
   c. Easy access of all components.
5. Dehumidifying Air Heater:
   a. Automatic temperature control.
   b. Thermoelectric cooler and air re-heater.
   c. Keeps polymer dry in high humidity environment.
6. Polyductor:
   a. 20 gpm nominal water flow capacity.
   b. Designed for dry polymer service.
   c. High suction air flow:
      1) Causes polymer to enter polyductor.
      2) Keeps polymer suction tube walls clean of particles.
7. Tank Level Control Package:
   a. Stainless probes:
      1) Monitor tank level.
      2) Detect: Low level, fill, start level, fill stop level, high level.
   b. Valves for control purposes.
   c. 420 mA signal.
8. Aging Tank:
   a. Quantity: One (1).
   b. Disperse and hydrate minimum of 50 pounds per day of polymer.
   c. Average aging: 30 minutes.
   d. Material: polyethylene.
   e. Vertical with minimum of 8-inch removable cover.
   f. Drain.
9. Electrical Panel:
   a. NEMA 4X fiberglass enclosure.
   b. PLC control.
   c. Manual or automatic operation through switches.
   d. Alarms:
      1) Local - visual and auditory.
      2) Remote indications contacts.
   e. 120 VAC, 15 amps.
10. Supply Water Controls:
    a. Pressure regulator with built-in strainer, material brass.
    b. Solenoid valve: electrically operated with brass body.
    c. Flow meter.
    d. Adjusting valve, brass.
11. Operating Conditions:
    a. Flow of supply water: 10 gpm minimum.
    b. Pressure of supply water: 40 psig minimum, 100 psig maximum.
12. Bag Loader:
    a. Dust tight.

b. Allows for easy and safe bag loading.
c. Hydrofluosilicic Acid:
1) Protective Safety Gear:
a) Gauntlet neoprene gloves:
(1) 12" minimum glove length.
(2) Quantity: 4 pairs.
(3) Size: Large and X-Large.
b) Full 8-inch face shield:
(1) Quantity: 3.
(2) For protection from hydrofluosilicic spill, spray, or leak.
c) Neoprene Aprons:
(1) Heavy duty acid type.
(2) Quantity: 3.
d) Chemical Respirators:
(1) Cartridges for acid gases.
(2) Quantity: 3.
e) Spill Control Pillows:
(1) Absorbs up to 10 times its weight.
(2) Size Range: 1 to 4 liters.
(3) "Foamed-sand" type.
(4) Quantity: 3 of each size.
2) Safety Shower and Eye Wash Station:
a) See Section 15440.

C. Miscellaneous Appurtenances:
1. Strainer for sodium chlorite and sodium permanganate tubing:
a. Material: PVDF.
b. Coordinate size with tubing size per Section 11240.
2. Strainers:
a. Rating: to match supply water pressure rating.
b. Type: Y-type basket strainers, 20 mesh.
c. Connections: Threaded or flanged.
d. Materials: Compatible with chemical.
e. Installation: Each to be complete with ball valve or blowoff and piping to drain.
3. Check Valves:
a. Compatible with chemical.
b. See Section 15106.
4. Backflow Preventer:
a. Compatible with chemical.
b. See Section 15114.

D. Provide a minimum of a 30-day supply of NSF approved chemicals as indicated in the following table:

Symbol	Name	Strength	Quantity
NaOH	Caustic or Sodium Hydroxide	25%	5,600 gal.
H_2SiF_6	Hydrofluosilicic Acid	23%	1,660 gal.
$NaMnO_4$	Sodium Permanganate	20%	280 gal.
$Cl_2(g)$	Gaseous Chlorine	100%	15,000 lbs.
Polymer	Cationic Polyacrylamide Cytek-492	100%	120 lbs.
PAC	Powder Activated Carbon	100%	15,000 lbs.
PACl	Polyaluminum Chloride	100%	11.700 gals.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Install all equipment in accordance with manufacturer's recommendations and associated standards.

C. Components shall be installed to complete system and all for a complete system.

D. Keep all components clean and dry.

E. Adequately support and anchor the components to the structure or wall with corrosion resistant fasteners.

F. Install equipment plumb and level.

G. Clearly label all safety gear and check each item for defects. Defective items shall be replaced.

H. Put safety gear in designated locations with Owner's approval.

I. Store chemicals in completed storage locations or where directed by District personnel. Protect chemicals from weather and spillage.

3.2 FIELD QUALITY CONTROL

A. See Section 11005 - Equipment: Basic Requirements.

B. Test scales and polymer feed system per manufacturer's recommendation.

C. Test valves, backflow preventers, and strainers per respective sections.

D. Field Services for Scales and Polymer System:
   1. Provide one man-day of on-site services by the manufacturer's factory-trained representative after the work is installed, cleaned, and tested.
   2. Include the following services:
      a. On-the-job training for operations and maintenance personnel of the Owner.
      b. Safety inspections and instructions.
      c. Preventative maintenance instructions.
      d. Assistance with cleaning or tune-up.
      e. Calibration check and re-calibration of instruments.
      f. Shut-down instructions.
      g. Start-up and commissioning instructions.

3.3 DEMONSTRATION

A. The system supplier shall be responsible for the testing and start-up of the system, including pressure testing, adjusting, calibration, and operation of all local and remote components and instruments of the system.

B. Demonstrate proper functioning of the operating system in all modes to the Engineer.

C. Demonstrate operation over the entire range and all controls and alarm conditions.

END OF SECTION

SECTION 11927

CHEMICAL FEED: BULK TRANSFER SYSTEMS

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SECTION 11927

CHEMICAL FEED: BULK TRANSFER SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bulk Chemical Transfer pumps for:
      a. Caustic (NaOH) Bulk Transfer Pump (P401)
      b. PACL (FeCl3) Bulk Transfer Pump (P402, P403)
      c. Hydrofluorosilicic Acid Bulk Transfer Pump (P309, P404)
      d. Additional pump P404a as a spare which will not be installed but stored for future installation if one pump fails.
   2. Accessories for all pumps listed in this section.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   5. Section 15100 - *Valves: Basic Requirements.*
   6. Section 15183 - *Pipe, Duct and Equipment Insulation.*
   7. Section 17000 - *Instrumentations and Controls.*

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C581, Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber- Reinforced Structures Intended for Liquid Service.
      b. C582, Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminated for Corrosion Resistant Equipment.
      c. D2584, Test for Ignition Loss of Cured Reinforced Resin.
      d. D3299, Specification for Filament-Wound Glass Fiber Reinforced Polyester Chemical-Resistant Tanks.
      e. D4097, Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.
   2. Uniform Building Code (UBC).

B. Secure and coordinate entire system including but not necessarily limited to metering pumps, electric equipment, controls, hardware, valving, and piping through the metering pump manufacturer.

1.3 SYSTEM DESCRIPTION

A. All components and Accessories shall be supplied through a single source and include all components specified herein.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - Equipment: Basic Requirements.
   2. Drawings and product data:
      a. See Section 11060 - Pumping Equipment: Basic Requirements.
      b. Pump:
         1) Chemical resistance data for materials used.
         2) Complete performance information:

a) Capacity, operating range.
b) Pressure rating.
c) NPSH required.
d) Stroke speed, length.
e) Horsepower required.
f) Plunger diameter.

c. Valves:
1) See Section 15100 - Valves: Basic Requirements.

d. Piping:
1) See Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

e. Control modes.

B. Operation and Maintenance Manuals.
1. See Section 01340 - Shop Drawings, Product Data and Samples; Operations and Maintenance Manuals; and Miscellaneous Submittals.

1.5 JOB CONDITIONS

A. Pumped Liquid:

Liquid	Strength	Temp (°F)
Caustic (NaOH), 50%	25%	50-104
Polyaluminum Chloride	100%	50-104
Hydrofluorosilicic Acid	23%	50-104

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to Section 01060 - *Major Equipment Suppliers*

B. Subject to compliance with the Contract Documents the following models are acceptable:
1. Magnetic Centrifugal pumps and accessories:
a. Pulsafeeder IsoChem Model CMC
b. Goulds Model 3298

C. Submit requests for substitution in accordance with Specification Section 01640 - *Product Substitutions*.

2.2 METERING PUMPS

A. MATERIALS
1. Magnetic, Leak Free, Centrifugal Pump

Pump Component	All Pumps
Port Connection & Pump Body	Alloy C or ETFA
Thrust Bearings	PTFE
Impeller Assembly	Alloy C or ETFA
Bearing and Shaft Material	Silicon Carbide

B. Pump Performance and Design Requirements:

1. Units shall have the following characteristics:

Tag Number	P401	P402, P403
Chemical	Caustic (NaOH)	PACL
Capacity (gpm)	60	60
Total Dynamic Head (ft)	50	50
Efficiency (%)	38	38
Shutoff Head (ft)	75	75
RPM (Max)	3450	3450
Drive:	Close Coupled	Close Coupled
Motor -	DC, 3 HP, 3 PH, 460 V	DC, 3 HP, 3 PH, 460 V
Variable Speed	No	No
Tag Number	P404, Spare pump P404a	
Chemical	Hydrofluorosilicic Acid (H_2SiF_6)	
Capacity (gpm)	60	
Total Dynamic Head (ft)	50	
Efficiency (%)	38	
Shutoff Head (ft)	75	
RPM (Max)	3450	
Drive:	Close Coupled	
Motor -	DC, 3 HP, 3 PH, 460 V	
Variable Speed	No	

C. General:
1. Pump casing strength to withstand 150 percent of shutoff head.
2. Pump shall be equipped with casing drain to allow complete drainage of the pump.
3. Fabricate casing for impeller removal without disturbing suction and discharge piping.
4. Pump shall incorporate a seal-less design.

D. Impeller:
1. Impeller shall be statically, dynamically, and hydraulically balanced.
2. Pump manufacturer shall be fully responsible for the complete pumping unit to provide vibration limits per H.I. Standards per Figure 1.105 of ANSI/HI 1994 over the range of operating conditions specified herein.
3. Install replaceable type wear rings.
4. Impeller shall be one piece enclosed.

E. Magnetic Drive:
1. Use high strength neodymium iron magnets with hard start capability
2. Drive shall be synchronous.

F. Bearings, Bearing Support, and Frame:
1. Supply bearings for a minimum L-10 life of 100,000 HRS at best efficiency point.

G. Motors:
1. Motors shall be constant speed.
2. 460, 60HZ, 3 PH
3. Totally enclosed fan cooled type with 1.15 service factor.

4. Size motor to drive pump continuously over the complete head - capacity range without the load exceeding the nameplate rating.
5. Design motor for 40°C ambient.
6. Comply with Section 11005 - *Equipment: Basic Requirements.*
7. Manufacturer is responsible for coordinating motor with VFD manufacturer.

H. Controls:
1. Remote and local on/off
2. Pumps will shut off on high water signal from Ultrasonic in Day tanks

2.3 SOURCE QUALITY CONTROL

A. All Pumps:
1. Hydrostatically test volute at 150 percent of shut off head.
a. Furnish documentation of test.

B. Factory test one pump of each service category:
1. Measure head (FT) versus flow (gpm).
2. Furnish characteristic curve and include efficiency and horsepower.
3. Certify curves by registered professional engineer.

2.4 MAINTENANCE MATERIALS

A. Extra Materials:
1. Provide manufacturer's standard spare parts kit

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 11060 - Pumping Equipment: Basic Requirements.

3.2 FIELD QUALITY CONTROL

A. See Section 11060 - Pumping Equipment: Basic Requirements.

END OF SECTION

SECTION 11930

CHLORINE VAPOR SCRUBBER SYSTEM

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SECTION 11930

CHLORINE VAPOR SCRUBBER SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. Chlorine gas scrubber system for Chemical Feed Building capable of neutralizing to greater than 99.99% of an entire release of a 1-ton cylinder of chlorine gas.

B. The Contractor shall furnish and install an Emergency Chlorine Gas Removal (Scrubber) system complete, as specified and shown by the Contract Documents. This work shall include the installation of the scrubber unit and related mechanic, structural, electrical, and instrumentation work to make a complete, functioning system.

C. The Contractor shall furnish and install a complete, 'once-through', chlorine gas adsorption system based on a packed-bed chlorine vapor-removal system. The vapor removal system shall be an induced air, dry chemical scrubbing process and include a dry-packed scrubbing media set within a vertically set FRP vessel, an exhaust blower/motor assembly, ductwork, chlorine leak detectors, and all other equipment and accessories as specified to provide a total system.

D. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11921 - *Chemical Feed: Chlorine.*
   4. Section 15010 - *Equipment: Basic Requirements.*
   5. Sections 15605, 15620, 15890, and 15990.
   6. Division 16 - Electrical.

1.2 QUALITY ASSURANCE

A. Codes: The Contractor shall comply with the rules and regulations of authorities having jurisdiction over the work specified herein, including but not limited to, the 2006 Virginia Statewide Prevention Fire Code including the requirements relating to treatment systems for Toxic and Highly Toxic Compressed Gases, and the 2006 Virginia Construction Code.

B. The products furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

C. All equipment under this Section shall be supplied by a single supplier regularly engaged in the design and assembly of emergency chlorine vapor scrubber systems for at least 10 years.

D. Codes: The Contractor shall comply with the rules and regulations of authorities having jurisdiction over the work specified herein, including but not limited to, the 2006 Virginia Statewide Prevention Fire Code with local amendments and the 2006 Virginia Construction Code.

E. All materials and fabrications furnished in accordance with this specification shall comply with all federal and state laws and local ordinances of the place and installation and with applicable codes and standards. Unless otherwise noted, the document with addenda, amendments, and revisions in effect on the date of the purchase order will apply.

F. Installation shall comply with NFPA 1 Uniform Fire Code.

G. Chlorine Institute Pamphlet 89: Chlorine Scrubbing Systems and Pamphlet 73: Atmospheric Monitoring Equipment for Chlorine.

1.3 SUBMITTALS

A. Certificate of product liability insurance.

B. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Product technical data including:
      a. Drawings of system showing assemblies, arrangements, piping, electrical, mounting details, equipment outline dimensions, fitting size and location, motor data, operating weights of all equipment and sufficient information to allow the ENGINEER to check clearances, connections, and conformance with the specifications.
      b. Materials of construction of all equipment.
      c. Manufacturer's catalog data, operating literature, and performance data confirming conformance to specifications.
      d. Manufacturer's installation recommendations.
      e. Complete instrumentation, control, logic and power wiring diagrams in sufficient detail to allow installation of the instrumentation, controls, and electrical components.
      f. Media performance tests.
      g. Manufacturer guarantee of performance.
      h. Certification that scrubber supplier accepts full system responsibility.
      i. Operation and Maintenance Manuals.
      j. Structural calculations for the scrubber tank.

C. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. See Section 01062 - *Major Equipment Suppliers.*

B. Submit requests for substitution in accordance with Specification Section 01640 - *Product Substitutions.*

C. A single manufacturer shall be responsible for the overall performance of the vapor scrubber system. Only those manufacturers who also manufacture and furnish dry chemical media, which meet the requirements of this specification, shall be accepted.

D. Manufacturers shall carry $2,000,000 additional product Liability Insurance.

E. Only those manufacturers who have successfully tested and have published test data prior to bid, on an actual prototype dry-chemical chlorine scrubber or a full bed depth scrubber, to verify system performance, will be accepted as the supplier. Such testing shall have been conducted in a representative section of the full-scale scrubber, at full-scale media bed depth, and equivalent chlorine loads. Testing may also include data from real events.

2.2 PERFORMANCE CRITERIA

A. The system shall be fully automatic and shall be designed to neutralize the entire contents of an overfilled one-ton cylinder containing a total of 2,350 pound of chlorine gas (Cl_2). The vapor removal system shall remove at least 99.998% of the chlorine. The manufacturer shall also demonstrate that the discharge (to atmosphere) concentration from the system will be 1 ppm or less of chlorine.

B. The Emergency Chlorine Scrubber shall be a single-pass system, 5,000 cfm capacity, which draws vapor from contaminated room, treats the vapor, and discharges to the atmosphere outside the building. The system shall also lower the concentration in the room to less than

1 ppm in less than 45 minutes per 10,000 cubic feet of room volume after the leak has stopped.

C. The Emergency Chlorine Scrubber shall provide sufficient draft to overcome the resistance of ductwork, fittings and dampers to maintain a negative pressure in the room, ductwork and scrubber to prevent atmosphere leakage of vapor.

D. The Emergency Chlorine Scrubber shall be designed for complete and automatic operation in response to signals from remotely located leak detectors or in response to manual activation.

E. The Emergency Chlorine Scrubber shall be designed to function in ambient temperature range of 20°F to 110°F.

F. The scrubber system supplier shall be required to provide to the Contractor, for review and approval by the Engineer, a complete set of approval drawings, and design calculations.
   1. Design calculations shall include a profile of chlorine concentration with time in the room for the entire duration of the leak itself, and reduction of the concentration to 1 ppm after the leak has stopped.
   2. In addition, prototype test data shall verify the gas handling capacity of the system, including time-temperature profiles for the dry media bed and the discharged air (from scrubber), and volume flow rate at the scrubber inlet.
   3. Drawings shall indicate the size of packing elements and number and height of packed media beds. Manufacturer's calculations shall confirm scrubber system operation with a minimum 1.3 safety factor (mass of chlorine removed) based on a 2000-lb design.
   4. A professional engineer, registered in the State of Virginia shall certify design.

2.3 SCRUBBING SYSTEM OPERATION

A. In the event of a chlorine leak, the emergency chlorine scrubber system will be automatically placed into operation by either a signal from a chlorine detector in the room set at 3 ppm chlorine, or a remote signal.

B. Upon sensing the presence of chlorine in the chlorine building, the ambient chlorine gas detector and associated controls will shut down the normal room ventilation fan(s), and close the motorized damper(s) at the fan inlet(s) or exhaust to prevent the discharge of chlorine gas to the atmosphere. Upon detection of chlorine gas, the control system shall start the emergency chlorine scrubber exhaust blower.

C. The blower shall continually draw the contaminated air from the chlorine building through the inlet duct to the scrubber vessel where it will be neutralized by the dry scrubbing media. As the blower creates a negative pressure in the room, makeup air openings located in or near the ceiling area of the room will open and allow fresh air to enter, as required. Upon exiting the dry media bed, the cleaned air shall be drawn into the blower and exhausted to the atmosphere through the discharge ducting.

D. The system shall operate until the concentration of chlorine in the room is reduced to less than 1 ppm and the scrubber is turned off manually.

2.4 COMPONENTS

A. Scrubber Vessel:
   1. The scrubber housing shall be an FRP vessel, with approximate dimensions of 8- to 10-foot diameter and 14- to 21-feet peak height, not including ladder or platform railing.
   2. The housing shall be provided with the following accessories as outlined in the Contract Drawings and as listed below:
      a. Two (2) 24-inch diameter manway. One located at top and one located on side of vessel.
      b. Two (2) 18-inch flanged nozzle-gas inlet and gas outlet.
      c. FRP exterior ladder with protective cage assembly.

d. Minimum of four (4) scrubber media sample ports at top and side of vessel.
e. FRP scrubber media support structure and FRP perforated support screen.
f. Scrubber media bed pressure gauge taps.
g. 2-inch flanged side drain.
h. Four (4) 1-inch lifting lugs.
i. Four (4) 1-inch tie-down lugs.
j. 5-foot minimum exhaust stack with wet weather protection hood and bird screen on blower outlet.

3. The scrubber tank shall be either filament wound in accordance with ASTM D3299 or custom contact-molded in strict accordance with NBS Voluntary Product Standard PS15-69 and ASTM Specification D-4097. The tank shall be fabricated of FRP (EION 9200 or Hetron 922, or Derakane 411 Vinyl Ester Resin with an MEKP cure system). Other premium resins may be considered if certified letter of suitability for the service is presented to and approved by the Engineer. The resin and cure system shall be suitable for continuous exposure to aqueous chlorine and wet chlorine gas. Gas connections shall conform to Table 2 of PS 15-69. Piping connections shall be flat-faced flanges with ANSI B16.5 drilling and thickness per Table 5 of PS 15-69. All exterior FRP surfaces shall have a pigmented resin for UV protection. The final gel coat shall be white.
4. The corrosion barrier on the inner surface shall be a resin rich layer, 10-20 mil minimum, not to exceed 10% +/- 5% "C" glass by weight, using Hetron 922 vinyl ester resin inner layer composed of resin reinforced, non-continuous, glass fiber strands applied in two piles of chopped strand mat, equivalent to 3 oz./ft. As an alternative method, two passes of chopped roving, of minimum length 1/2 - 2 inches, shall be applied uniformly by spray process up to an equivalent weight.
5. Filament wound laminates shall have an average glass content of 50-55%, by weight.
6. Hand lay-up laminates, when used on the vessels and equipment, shall be fabricated to meet the physical properties in accordance with PS 15-69 product standard, factory-coated with a UV protective gel to a minimum dry film thickness of 15 mils.
7. Aluminum tanks shall not be allowed.

B. Dry Media:

1. Provide chemically impregnated media to scrub chlorine gas. The media shall be generally spherical in shape, porous, and UL Class I and capable of removing, absorbing, and adsorbing chlorine throughout the entire media bed. Impregnants shall be applied such that the impregnate is uniformly distributed throughout the pellet volume. Media shall be capable of absorbing and removing chlorine throughout the entire pellet volume and shall be UL Class 1 listed as non-flammable. Spent media shall be non-toxic and landfill disposable. Media performance tests performed by an outside testing agency and providing media capacity to remove the specified amount of chlorine shall be submitted for approval.
2. Quantity: Minimum 31,000 pounds.
3. Design scrubber Air Rate: 4,000 scfm minimum.
4. Average Crush Strength: 35% minimum to 70% maximum.
5. Average Density: 50 pounds/ft^3 minimum.
6. Average Media Diameter: 1/8" to 3/16".
7. Pressure Drop Characteristic: The pressure drop of air at 70 F flowing through a 12-inch deep, packed media bed shall not exceed the following limits:

Superficial Velocity (fpm)	Pressure Drop (in. w.c.)
50	0.45
100	1.85

C. Exhaust Blower:

1. The blower shall be of FRP construction, externally mounted, belt driven, with backward inclined blades, and sized to deliver a minimum of 4,000 CFM of air flow. Scrubber supplier shall verify that the capacity is sufficient to overcome the ducting, scrubber tank/media, and stack losses.

2. Blower shall be mounted to draw contaminated air from the building through the scrubber, maintaining the scrubber, chlorine storage room, and chlorinator area at a slight vacuum.
3. Motor shall be 20 hp minimum, 460 volt, 3 phase, 60 Hz with a TEFC enclosure rated for severe duty. Additional motor requirements shall be as specified.

D. Differential Pressure Gauge: Gauges shall be installed across each media stage to measure filter purity. Gauges shall be Dwyer Magnahelic Series 2000, or equal, with range as specified by scrubber manufacturer and shall conform to Section 13449 - *Primary Elements and Transmitters*.

E. Connecting Ductwork: The scrubber system manufacturer shall provide the fiberglass ductwork to be installed by the Contractor between the scrubber vessel and exhaust blower inlet. The ducting shall include flexible duct connectors. Ductwork assembly and design shall be compatible with the vessel and blower and shall be manufactured in accordance with ASTM D-3299 and/or product standard PS 15-69. A UV protective gel coat shall be factory applied at a minimum 15-mil dry film thickness.

F. An FRP duct system, as specified in Section 15800, shall be furnished and installed to convey a vapor release from the Chlorine Storage Room and Chlorinator area to the Chlorine Vapor Scrubber System shall be as specified in Section 15800 - *Heating, Ventilating, and Air Conditioning*.

G. Emergency air intake shall be a backdraft, barometrically weighted damper without the need for a motor to open it in emergency applications and be provided by Contractor.

H. Motor starter shall be wall mounted circuit breaker combination magnetic type, NEMA 4X enclosure with lockable, external handle, 230 or 460 volt, 3 phase with 120 volt control transformer. Motor starter enclosure shall be free-standing, mounted on channel support framing system, located where shown on the Drawings.

I. Motor starter shall have a nameplate for identification. The nameplate shall be black plastic with white engraved letters and shall be securely fastened to the motor starter enclosure.

J. Manufacturers: ITE Siemens, Square D, Allen Bradley, or equal.

K. The following input and output signals should be provided:
   1. Inputs:
      a. 230 or 460 volt from power source.
      b. 120 volt control signal from instrumentation control panel.
   2. Outputs:
      a. 120 volt to instrumental control panel.
      b. 230 or 460 volt to blower motor.

L. All equipment shall be installed outside and rated accordingly. Equipment supplied shall be vandal protected.

M. Neoprene Pad: A 1/4" thick, 60 durometer neoprene rubber sheet must be placed underneath the scrubber vessel.

2.5 CONTROL PANEL

A. The scrubber system shall be furnished with Local Control Panel with an FRP NEMA 4X enclosure to house the required controls, hinged and lockable. Panel shall be internally wired with 16 GA stranded MTW (machine tool wire) to numbered terminal blocks. All electrical work in the panel shall conform to the requirements of the National Electric Code. Voltage to the panel shall be 120 volts, 1 phase, 60 Hz through a 10 amp fused terminal block having a dual element or time delay fuse. Control Panel enclosure shall be free-standing, mounted on channel support framing system, located where shown on the Contract Documents.

1. All panel mounted switches shall be heavy duty, oil tight switches, rated for 600 VAC, Allen Bradley Bulletin 800, Square D, or equal.
2. The control panel shall include the following switches and lights:
   a. System HAND-OFF-AUTO Switch.
   b. System "READY" Status Light.
   c. Blower HAND-OFF-AUTO Switch.
   d. Blower "Run" and "Off" Lights.
   e. Blower FAIL Light.
   f. Chlorine Storage Room Leak Light
   g. Power On Light.
3. Motor shall include running time meter.
4. The following input and output signals should be provided:
   a. Inputs:
      1) 120 V from Motor Starter/Transformer control panel.
      2) chlorine storage room leak detector.
   b. Outputs:
      1) Exhaust fan.
      2) Automatic inlet damper.
      3) Motor starter control panel.
      4) 120 volt to auxiliary panel.
      5) Remote alarm to signal system is activated.
      6) Unit failure.

B. The Emergency Chlorine Scrubber shall operate manually in response to hand switches or automatically in response to contact closures at remote leak detectors. The system shall normally remain in automatic mode for standby conditions. System response for manual and automatic modes is described below.

1. Manual Control:
   a. The control system shall provide for manual control of the following items:
      1) System Ready [Hand-Off-Auto]
      2) Scrubber Exhaust Fan [Hand-Off-Auto]
   b. Manual control shall be enabled by turning a HAND-OFF-AUTO switch for the respective piece of equipment to the HAND setting. The selected device shall start, an indicating light will energize to denote that it is operating.
2. Automatic Control:
   a. The control system shall provide for automatic control of the scrubber such that when the HAND-OFF-AUTO switches noted above are set to AUTO, the scrubber system shall operate automatically based on a signal from a Chlorine Detector in the chlorine storage or chlorinator areas.
   b. When the Local Control Panel receives a start signal from the chlorine detector, the blower shall start. Status pilot lights shall energize to indicate that the blower is operating.
   c. Ensure that HVAC is coordinated with scrubber controls.
   d. All wire and cable, gas detection equipment, motor starting and control equipment, and signal and alarm devices shall be as specified in Section 11261 and pertinent sections within Divisions 16 and 17 of these Contract Specifications.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Upon completion of installation of the scrubber system, the Contractor shall be responsible for performing an acceptance test to verify the satisfactory operation of the system and the design performance requirements of the specification. As a minimum the test shall include but not be limited to the following:

1. The test shall be witnessed by the Owner and local Fire Department.

2. The test shall simulate the whole system performance as specified for a minimum of 30 (30) minutes:
   a. Airflow and Pressure Simulation Tests: The air load rate to test the system shall, as a minimum, simulate a full-scale operation at 400 lb. of Chorine/min for one minute, followed by 80 lb. chlorine/min load for the balance of the test to provide a total equivalent full-scale load of 2,350 lb. During this simulation, 3-ppm of chlorine gas shall be introduced for a period of two (2) minutes. Test results shall demonstrate a continuous air discharge containing less than 1ppm chlorine concentration throughout the duration of the test. Tests shall verify that the proposed scrubber system will perform, as specified, with media at a start-up temperature as low as 20°F, without the requirement for supplemental heating.
   b. Test data shall include:
      1) Media temperature.
      2) Air discharge temperature.
      3) combined Cl_2 and air volume flow rate at scrubber inlet during test.
      4) Continuous recording of scrubber discharge Cl_2 concentration, measured to +/- 0.1 ppm accuracy.
3. The system shall be tested for leakage in accordance with SMACNA, "HVAC Air Duct Leakage Test Manual", for 12-inch w.c. vacuum pressure, except that there shall be no allowable leakage.

3.2 WARRANTY

A. Manufacturer shall guarantee the whole system, both in material and workmanship for a period of three (3) years from the day of final acceptance. Manufacturer shall guarantee the performance of the chlorine vapor scrubber in accordance with the design criteria specified herein. Manufacturer shall repair or replace, at manufacturer's own expense, any material that may prove to be defective during the period of this guarantee.

3.3 MANUFACTURER'S SERVICES

A. The system manufacturer's representative shall be present at the job site for the following time period; travel time excluded:
   1. Sixteen (16) hours for installation assistance, inspection, and certification of the installation.
   2. Sixteen (16) hours to inspect the system and assist the Contractor in field performance tests.
   3. Eight (8) hours to train Owner's staff in operation of the system, including safe chemical handling procedures.
   4. Eight (8) hours to provide one additional visit, at Owner's request, within 12 months of system acceptance for system inspection, operator training, and function checking of system components.
   5. Manufacturer shall provide certification that the emergency dry gas scrubber is properly installed, tested, and ready for full-time operation.

3.4 FIELD PAINTING

A. Field paint in accordance with Section 09905 - *Painting and Protective Coatings.*

END OF SECTION

SECTION 11948

FLOCCULATION BASIN MIXERS

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SECTION 11948

FLOCCULATION BASIN MIXERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. New flocculation basin mixers (open tank fixed mount variable speed).

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA):
      a. L-10 Standards--Standards 9 and 11, Method for Evaluating and Load Rating of Bearings.
   2. American National Standards Institute/American Gear Manufacturers Association (ANSI/AGMA):
      a. 211.02, Standard for Surface Durability of Helical and Herringbone Gear Teeth.
      b. 221.02, Standard for Rating the Strength of Helical and Herringbone Gear Teeth.
      c. 390.03a, Gear Handbook, Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Worm gearing and Racks Only as Unassembled Gears.
      d. 2000-A88, Gear Classification and Inspection Handbook, Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
      e. 6001-C88, Design and Selection of Components for Enclosed Gear Drives.
      f. 6025-C90, Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives.
   3. American Iron and Steel Institute (AISI).
   4. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Structural Steel.
      b. A48, Gray Iron Castings.
      c. A153, Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.
      d. A307, Low-Carbon Steel Externally and Internally Threaded Standard Fasteners.
   5. American Welding Society Publication (AWS):
      a. D1.0, Code for Welding in Building Construction.
   6. Institute of Electrical and Electronics Engineers (IEEE).
   7. National Electrical Manufacturers Association Standards (NEMA):
      a. MG-1, Motors and Generators.
   8. Occupational Safety and Health Act (OSHA).

1.3 SYSTEM DESCRIPTION

A. Provide four (4) identical open tank top mounted gear reduced, slow speed mixers for mixing in 17'-0" x 17'-0" x 12'-8" concrete tanks with liquid depth of 11' 4 ½".

B. Mixers shall be variable speed to be used for tapered flocculation. Speed adjustment shall be provided by means of a variable frequency drive. Mixers are considered Major Equipment (see Section 01062 - Major Equipment Suppliers).

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Drawings and product data.

a. Chemical resistance data for materials used.
b. Product technical data:
1) Provide calculations supporting all shaft and impeller design criteria (stresses and critical speeds).
2) Submit all loadings, torques and forces imposed by operating equipment.
3) Pumping capacity and water horsepower at delivered power.
4) Tip speed and velocity gradient ("G") calculations.

B. Operation and Maintenance Manuals:
1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Flocculation Basin Mixers are designated Major Equipment. See Section 01062 - *Major Equipment Suppliers.*
1. Variable-speed drives (by allowance):
a. Ben Shaw.
b. Or Engineer-approved equal.

B. Submit requests for substitution in accordance with Specification Section 00100.

2.2 MATERIALS

A. Mixer Housings: Fabricated steel or cast iron.

B. Impeller Shaft: Stainless steel, AISI Type 316.

C. Impeller: Stainless steel, AISI Type 316.

2.3 EQUIPMENT

A. Performance and Design Requirements:
1. Mixers:
a. Maximum motor horsepower: 3 HP, 3 Phase, 460 V, 60 Hz.
b. Velocity gradient (G): 50 - 75 $Second^{-1}$
c. Shaft speed: 34 rpm, maximum.
d. Motor speed: 1750 rpm
e. Fluid viscosity: 1.0 cps
f. Number of impellers per mixer: 1
g. Impeller diameter: 66"
h. Drive type: Variable speed.
i. Maximum tip speed: 8.6 FT/S
j. Impeller pumping capacity: Greater than 1.50 of average flow.
k. Shaft diameter: 3.5"

2.4 FABRICATION

A. Speed Reducer:
1. Designed and rated per AGMA standards with AGMA nameplate.
2. Type:
a. Right angle or vertical incline gear drive.
b. Minimum double gear reduction.
c. Combination helical, spiral bevel, and pinion drive gears.
d. Totally enclosed.
e. Worm gears not acceptable.
3. Service factor: 2.0 of nameplate on motor.

4. Gearing: AGMA quality number 10 or better ANSI/AGMA 2000-A88.
5. Bearing design:
   a. Antifriction type, ball or roller, oil or grease lubricated.
   b. All shaft bearings located outside of tankage.
   c. All bearings minimum ABMA L-10 life of 100,000 HRS full motor nameplate HP at design speed.
6. Lifting lugs.
7. Lubrication:
   a. Oil or grease lubricated.
   b. Positive lubrication of all gears and bearings.
   c. Maintain recommended thermal rating of reducer Provide cooling system, and oil pumps if required.
   d. Dipstick oil level indicators.
   e. Adequate separation between oil and grease lubricated parts.
   f. Oil breather located above possible oil foam level.
8. Lubricating provisions:
   a. Oil drain.
   b. Grease fittings protected by removable neoprene cover and easily accessible.
   c. Greased bearings with seal to retain grease.
9. Reducer agitator and output shaft and impeller shaft.
   a. Agitator shaft oversized for direct, rigid coupling to impeller shaft below reducer.
   b. Maximum indicated runout at lower end of impeller shaft not to exceed 1/8 IN for every 10 FT of overhang, as measured when turning by hand.
   c. Maximum stress: 8,000 psi at maximum load.
   d. Full load noise level not to exceed 85 dBa at 3 FT from any part of the drive assembly.

B. Impeller:
1. Axial flow basic design.
2. Dynamically and hydraulically stable.
3. Blades bolted to hub, impeller hook keyed to impeller shaft.
4. Maximum stress on impeller component not to exceed 11,000 psi under maximum operation load.
5. Use of stabilizing rings or fins will not influence stress limitations specified.
6. Shaft impeller system design; operating speed does not exceed 70 percent of its first critical speed.

C. Shaft Coupling:
1. Rigid flange on agitator shaft located for ease of access.
2. Designed to transmit 200 percent of full torque and 150 percent axial load.
3. Located outside tankage.
4. Faces provided with rabbeted male and female piloted connection.
5. No match marks required for alignment.

D. Controls:
1. Provide a variable frequency drive with each mixer to achieve required speed variation.

E. Motor:
1. Inverter Duty, 3 HP, 460 V, 3 Phase, 60 Hz
2. Totally Enclosed Fan Cooled
3. Drip cover over top or end of motor if motor is vertically mounted.
4. NEMA-C flange mounted
5. See Section 11005 for additional requirements.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Comply with Section 11005.

3.2 FIELD QUALITY CONTROL

A. Employ and pay for services of authorized manufacturer's field service representative to:
   1. Inspect equipment to be installed under these Specifications.
   2. Supervise any adjustments and perform modifications as necessary.
   3. Conduct start up of equipment.
   4. Instruct Owner's personnel a minimum of 8 hours concerning equipment operation.

END OF SECTION

SECTION 11999

IN-LINE STATIC MIXERS

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SECTION 11999

IN-LINE STATIC MIXERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. In-Line Static Mixers.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual.
   2. American National Standard Institute (ANSI).
   3. American Society for Testing and Materials (ASTM).
   4. Equipment dimensions, width and length with all injection parts shown.

1.3 SYSTEM DESCRIPTION

A. Furnish one (1) in-line static mixer for mixing alum/polymer into water flowing at a design rate of 8333 gpm. Mixers will be installed along 24" diameter (nominal) ductile iron pipe.

B. Furnish one (1) in-line static mixer, sch 40 316 stainless steel with 10 mixing elements in five sections.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Chemical Compatibility charts for all wetted component materials.
   2. Flow versus headloss chart showing the loss of head through the mixer under the range of flows up through 15 MGD.
   3. Documentation ensuring adequate mixing for water treatment coagulation at design flows.

1.5 WARRANTY

A. Equipment supplied under this section will be warranted against defects in workmanship for a minimum of two years or for manufacturer's standard warranty period, whichever is longer. The warranty will begin when the manufacturer's field representative(s) provide written notification that equipment is ready for operation.

B. Equipment or portions of the equipment replaced due to defects in workmanship during the warranty period will be covered by a new warranty of the same duration as the original warranty.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. See Section 01062 - *Major Equipment Suppliers.*

2.2 MATERIALS

A. Housing: Type 316 Stainless Steel.

B. Elements: Type 316 Stainless Steel.

C. Flanged end-connection: Carbon steel (lap joint).

D. All wetted surfaces: 316 Stainless Steel.

2.3 EQUIPMENT

A. Static in-line Mixer for Adsorption Clarifier (Koflow Model No. 24 or approved equal).
   1. Number of Mixing Elements: 3.
   2. End-connection type: Flanged.
   3. Fluid viscosity: 1.0 cps.
   4. Size and type of line into which mixer shall be installed: 24" diameter (nominal) Class 150 ductile iron pipe.
   5. Maximum design flow rate: 12 MGD.
   6. Design working pressure rating: 100 psig.
   7. Maximum head loss at 12 MGD: 4.3 psi.
   8. Maximum length: 109 IN.

B. Static In-line Mixer for 2" Solution Line.
   1. Number of Mixing Elements: 5.
   2. End Connection Type: NPT.
   3. Maximum Flow Rate: 30 gpm.
   4. Design Pressure Rating: 100 psi,
   5. Headloss: 1.7 psi at 20 gpm.

2.4 FABRICATION

A. Install injection ports as follows:
   1. 0.5-inch PACL.
   2. 0.5-inch $NaMnO_4$.
   3. 0.5-inch Polymer.
   4. 1.5-inch CLS.
   5. 2-inch PAC.
   6. 0.5-inch NaOH.
   7. 1.0-inch Spare.

B. Fully welded elements.

C. Avoid sharp edges.

D. All injection ports shall be contained within 270° of the static mixer.

PART 3 – PART - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Comply with Section 11005 - *Equipment: Basic Requirements.*

END OF SECTION

SECTION 13200

FIBERGLASS REINFORCED PLASTIC TANK

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SECTION 13200

FIBERGLASS REINFORCED PLASTIC TANK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fiberglass Reinforced Plastic (FRP) chemical storage tanks and appurtenances for storage: 23% Hydrofluosilicic Acid, Polyaluminum Chloride, and 25% Sodium Hydroxide.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 16858 - *Heat Tracing.*

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C581, Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber- Reinforced Structures Intended for Liquid Service.
      b. C582, Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminated for Corrosion Resistant Equipment.
      c. D2584, Test for Ignition Loss of Cured Reinforced Resin.
      d. D3299, Specification for Filament-Wound Glass Fiber Reinforced Polyester Chemical-Resistant Tanks.
      e. D4097, Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.
   2. American Water Works Association (AWWA):
      a. D120-02, AWWA Standard for Thermosetting Fiberglass - Reinforced Plastic Tanks.
   3. Uniform Building Code.
   4. NSF 61 or food grade.

1.3 SYSTEM DESCRIPTION

A. Tanks shall be supplied through a single source and include all components specified herein, including insulating, per Bulk Storage Tank Schedule, and heat tracing installed at the factory.

B. Design tanks for holding and resisting chemicals listed in the Bulk Storage Tank Schedule.

C. Tanks shall be NSF-61 approved or approved suitable for contact with food.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Submit resin selection and chemical compatibility.

B. Submit required diameter of supporting concrete slab.

C. NSF-61 or Food Grade Approval.

D. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

E. Certification that all materials are suitable for chemicals being stored.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. See Specification Section 01062 - *Major Equipment Suppliers.*

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 TANKS

A. General:
1. Design Loads:
   a. Seismic design information:
      1) Site Class C
      2) $S_s = 10.5$
      3) $S_1 = 5.4$
2. Wind Force: 90 MPH
3. Tank materials and resins to be resistant to chemical listed in the Bulk Storage Tank Schedule for ambient temperatures between -10°F and 110°F.
4. Material: Fiberglass Reinforced Plastic (FRP).
5. Shape: Vertical, circular sloped bottom, on concrete pad, dome-type top.
6. Penetrations and Connections:
   a. 24" Manway.
   b. 3" Flanged Outlet Port at tank bottom, with entire tank contents draining to this port.
   c. (2) 2" Penetrations for Level Indication site tube.
   d. 3" Gooseneck Screened Vent (Flanged PVC).
   e. 3" Flanged Overflow.
   f. 3" Fill Pipe Extended to a Depth of 2" above Tank Bottom.
   g. 4" Flanged Penetration for capacitance probe.
7. Inside tank bottoms shall slope towards drain.

B. Fabrication (Fiberglass Reinforced Plastic):
1. Conform to referenced standards.
2. Helical filament-wound side walls and contact molded top and base construction.
3. Minimum design safety factors and wall thickness per governing standard but not less than the following:
   a. Internal pressure: 10:1.
   b. External pressure: 5:1.
   c. Seismic loads: 3:1.
4. Sufficient resin on all surfaces to prevent fiber exposure.
5. Ends fabricated integrally with shell, or separately and laminated to shell.
6. Joints made with heavy reinforced lay-ups for structural stability and to prevent leakage.
7. Inner surface layer: 10 - 20 mils thick.
   a. Inner layer followed by laminate 80 - 90 mils thick, reinforced with noncontinuous chopped strand fiberglass.
   b. Laminate layer resin content: 80 percent. Total thickness of two layers at least 100 mils.
8. Structurally reinforce walls with helical filament winding of continuous strands, tops, and bases with fiberglass mat and/or woven roving. Thickness and glass content per tensile and flexural requirements.
9. Reinforcing ribs per manufacturer's recommendations.
10. Lifting lugs provided on tank.
11. Minimum wall thickness: 1/4 IN.
12. Penetrations to be factory installed in accordance with referenced standards.
13. Connections:
    a. All connections on tanks shall be flanged

b. All nozzles 4" diameter or less shall be reinforced with plate or conical gussets.

14. Coated with protective gel coat, color as selected by Engineer.

C. Appurtenances:

1. Outside tank ladder
   a. An outside tank ladder shall be furnished and installed as shown on the contract drawings. Use proper chemical resistant materials when anchoring to tank dome or sidewall
   b. Ladders shall be fabricated of FRP and utilize grooved, skid resistant rungs and shall meet applicable OSHA standards.
2. Identification Plate:
   a. A manufacturer's nameplate shall list the tank serial number, tank diameter and height, maximum design capacity, intended storage use, and date of installation. The nameplate shall be affixed to the tank exterior sidewall at a location approximately five (5') feet from grade elevation in a position of unobstructed view.
3. Sight gauge:
   a. A sight gauge shall be furnished and installed as shown on the contract drawings. The sight gauge shall be constructed of clear rigid pipe and allow for tank contraction and expansion for varying temperatures and various levels of filling. The pipe shall be connected to the tank with 2 inch fittings and valves for isolation and drainage purposes. All materials shall be resistant to chemical being stored.
4. Heat Tracing and Insulation:
   a. Provide heat tracing and insulation system direct from the manufacturer for Caustic and Fluoride tanks.
   b. Heat tracing and insulation system shall maintain the tank contents to 45°F for Hydrofluorosilicic Acid and 65°F for Caustic chemicals required on Schedule. Minimum ambient temperature should be considered to be -10°F.
   c. Provide 100% UV blocking, 2 lbs/ft3 density, min 2" thick insulation. R value = 8.33/in.
   d. Provide temperature controllers as an integral part of tank.
   e. System shall be 120V/single phase. Contactors and thermostat by tank manufacturer.

D. Shipping:

1. During shipment tank shall be secured and padded to prevent shifting or damage from transport.
2. Upon arrival at the destination, inspect tank for any damage. If damage or defects are observed, manufacturer shall provide new tank.

E. Installation, cleaning, testing

1. Install tanks in strict accordance with the manufacture's instructions and shop drawings
2. Prior to testing and operation, all dirt and extraneous materials shall be removed from the tank including surface markings, coatings, and contaminates.
3. After installation of tanks and all fittings, the tank shall be water tested. The tank shall be filled to operating levels with water and the tank, all fittings, and connections shall be observed for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field testing the tank shall be completely emptied dried and cleaned.

F. Warranty

1. Manufacturer shall provide a pars and labor warranty on the tank good for 5 years. If any leaks develop due to defects in materials or construction during that time manufacturer shall be responsible to repair or replace the tank or component.

Bulk Storage Tank Schedule

Stored Chemical	Nominal Capacity (gal.)	No. of Tanks	Maximum Overall Height (ft.)	Maximum Diameter (ft.)	Heated and Insulated
Hydrofluorosilicic Acid, 23%	7,200	1	9.7 ft.	12.5	Yes
Polyaluminum Chloride	6,500	2	9.7 ft.	12	No
Sodium Hydroxide, 25%	6,500	1	9.7 ft.	12	Yes

END OF SECTION

SECTION 13210

HIGH DENSITY POLYETHYLENE (HDPE) TANK

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SECTION 13210

HIGH DENSITY POLYETHYLENE (HDPE) TANK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HDPE chemical storage tank and appurtenances for storage of:
      a. Hydrofluosilicic Acid 23% - 1 tank.
      b. Polyaluminum Chloride - 2 tanks.
      c. Sodium Hydroxide 25% - 1 tank.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 16858 - *Heat Tracing.*

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. American Society for Testing and Materials (ASTM):
      a. D638, Tensile Properties of Plastics
      b. D790, Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
      c. D883, Standard Definitions of Terms Relating to Plastics
      d. D1505, Density of Plastics by the Density-Gradient Technique
      e. D1525, Test Method for Vicat Softening Temperature of Plastics
      f. D1693, ESCR Specification Thickness 0.125" F50-10% Igepal
      g. D1998, Standard Specification for Polyethylene Upright Storage Tanks, Section 11.3: Low temp. Impact Test and Section 11.4: Gel Test
      h. F412, Standard Terminology Relating to Plastic Piping Systems
   2. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings.
   3. OSHA Standards: 29 CFR 1910.106, Flammable and Combustible Liquids.
   4. UBC Code: Uniform Building Code, 1997 J Edition.
   5. NEMA ICS 6: Enclosures for Industrial Control and Systems.
   6. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure).
   7. NSF 61 or Food Grade.

1.3 SYSTEM DESCRIPTION

A. Tanks shall be supplied through a single source and include all components specified herein, including insulating and heat tracing installed at the factory.

B. Design tank for holding chemicals listed in Day Tank Schedule.

C. Tanks shall be NSF-61 approved or approved suitable for contact with food.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Resin selection and chemical compatibility.

B. Tank and Fitting Material:
   1. Resin Manufacturer Data Sheet.
   2. Fitting Material.
   3. Gasket style and material.

4. Bolt material.

C. Dimensioned Tank Drawings:
1. Location and orientation of openings, fittings, accessories, restraints and supports.
2. Details of inlet and outlet fittings, manways, flexible connections, and vents.

D. Calculations for Structural Design:
1. Wall thickness. Hoop stress shall be calculated using 600 psi @ 100 degrees F.
2. Tank restraint system. Show seismic and wind criteria.

E. NSF-61 or Food Grade Approval.

F. Operation and Maintenance Manuals:
1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents the following manufacturers are acceptable:
1. Tanks:
a. PolyProcessing Company.
b. Assmann Corporation.
c. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 TANKS

A. General:
1. Design Loads
a. Seismic design information:
1) Site Class C
2) $S_s = 10.5$
3) $S_1 = 5.4$

2. Tank materials and resins to be resistant to chemical at a maximum temperature of 110°F and a minimum temperature of -10°F.
3. Shape: Vertical, circular flat bottom, on concrete pad, dome-type top.
4. Penetrations and Connections:
a. 24" Manway, integrally molded into the tank
b. 1" Flanged Outlet Port.
c. 2" Flanged for Level Indication on tank top furthest away from outlet port possible.
d. 2" Flanged Vent (Flanged PVC).
e. 2" Flanged Overflow.
f. 2" Fill Pipe Extended to a Depth of 2" above Tank Bottom.
g. 4" Flanged nozzle top mounted for float switch.
5. Tanks shall be rotationally-molded high density crosslinked polyethylene, one-piece seamless construction, cylindrical in cross-section, vertical in axis. Covered tanks shall be vented, and tanks shall be provided with entrance manways, level indicators, and exterior coating. Tanks shall be marked to identify the manufacturer, date of manufacture and serial number.

B. Restraint System:
   1. Metal components to be galvanized or painted clips, edge softeners, and tension ring with stainless steel cables and clamps.

C. Fabrication:
   1. Conform to referenced standards.
   2. Minimum design safety factors and wall thickness per governing standard but not less than the following:
      a. Internal pressure: 10:1.
      b. External pressure: 5:1.
      c. Seismic loads: 3:1.
   3. Penetrations to be factory installed in accordance with referenced standards.
   4. On closed top tanks, the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall.
   5. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.
   6. Connections:
      a. All connections on tanks shall be flanged
      b. All nozzles 4" diameter or less shall be reinforced with plate or conical gussets.
      c. Integrally Molded Flanged Outlet Fittings: These fittings shall be an integral part of the tank and provide complete drainage of liquid through the sidewall of a flat bottom tank. The attachment shall be constructed from a PVDF flange and be standard at 3" or 4" inside diameter depending on the size of the tank.
   7. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be CPVC.
   8. Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). Vent nozzles shall be sized by the tank manufacturer. Vents shall be completed by Contractor and be furnished with insect screen, be constructed of material compatible with the chemical stored, and be vented to the outside of the chemical building.
   9. Attachments: Pipe attachments at fittings shall be equipped with flexible connections or have other provisions for movement. Piping attachments shall allow for movement in any direction.

D. Materials:
   1. Resin: SLPE with Oxidation Resistant System
   2. Fitting Material: PVDF
   3. Gasket Material: PVDF
   4. Bolt Material: Alloy C-276

E. Appurtenances:
   1. Identification Plate:
      a. A manufacturer's nameplate shall list the tank serial number, tank diameter and height, maximum design capacity, intended storage use, and date of installation. The nameplate shall be affixed to the tank exterior sidewall at a location approximately five (5') feet from grade elevation in a position of unobstructed view.

F. Shipping:
   1. During shipment tank shall be secured and padded to prevent shifting or damage from transport.
   2. Upon arrival at the destination, inspect tank for any damage. If damage or defects are observed, the tank shall be replaced at no cost to the Owner.

G. Installation, cleaning, testing
   1. Install tanks in strict accordance with the manufacturer's instructions and shop drawings

2. Prior to testing and operation, all dirt and extraneous materials shall be removed from the tank including surface markings, coatings, and contaminates.
3. After installation of tanks and all fittings, the tank shall be water tested. The tank shall be filled to operating levels with water and the tank, all fittings, and connections shall be observed for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field testing the tank shall be completely emptied dried and cleaned.

H. Double Contained Tanks (Hydrofluorosilicic Acid)
1. Contained tank shall hold 120% of inner tank volume.
2. Seven-inch threaded top access to containment area.
3. One-inch drain for contained area.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving.

B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately.

C. Upon arrival at the destination, inspect for damage in transit. If damage has occurred, manufacturer shall be notified immediately.

3.2 INSTALLATION

A. Install tanks in strict accordance with the manufacturer's instructions and shop drawings.

3.3 FIELD TESTING

A. Notification: Provide the Engineer two (2) working days notice prior to field tests so that the Engineer may elect to witness the testing.

B. After installation of tank and all fittings, the tank shall be water tested by the contractor. The tank shall be tested by filling the entire tank with water and monitoring the tank as well as all fitting connections for at least 24 hours. Leaks shall be corrected prior to acceptance. Following successful field testing, the tank shall be completely emptied and dried.

DAY TANK SCHEDULE

Stored Chemical	Nominal Capacity (gal.)	No. of Tanks	Maximum Overall Height (ft.)	Maximum Diameter (ft.)	Secondary Contained
Hydrofluorosilicic Acid, 23%	115	1	4'-4"	2'-6" Double Contained	Yes
Polyaluminum Chloride	600	2	7	4	No
Sodium Hydroxide, 25%	300	1	4	3'-6"	No

END OF SECTION

SECTION 14301

HOISTS, TROLLEYS, AND MONORAILS

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SECTION 14301

HOISTS, TROLLEYS, AND MONORAILS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hoists, trolleys, and monorails.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 14305 - *Bridge Cranes.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Gear Manufacturer Association (AGMA).
   2. American National Standards Institute (ANSI):
      a. B30.11, Monorails and Underhung Crawl - Safety for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings.
      b. B30.16, Overhead Hoists (Underhung).
      c. HST-4, Performance Standard for Overhead Electric Wire Rope Hoists.
   3. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
   4. National Electrical Code (NEC).

B. Comply with ANSI B30.11 and B30.16.

C. For hoists and trolleys provided for bridge crane mounting, the hoists, trolleys, and bridge crane components shall all be provided by the bridge crane supplier.

1.3 DEFINITIONS

A. Hook Height: The minimum acceptable distance in feet from bottom of hook in full raised position to the nearest floor surface.

B. Lift Height: The distance in feet from the bottom of the hook in full raised position to the surface of the lowest floor from which items may be hoisted.

C. Ultimate Load-Carrying Capacity: Live load, weights of all equipment and an allowance for impact.

D. Total Trolley Capacity: The ultimate load-carrying capacity of the trolley based on the ultimate strength of the material used (with a 5:1 safety factory) and the bearing life.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Reports of tests verifying strength of inserts and rail.
   3. Track layout including supports, splices, connections, switches, and end trucks.
   4. Load test results.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittols.*

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Hoists, Trolleys and Crane Components:
      a. Yale.
      b. Harrington.
      c. Coffing.
      d. Columbus McKinnon
      e. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MANUFACTURED UNITS

A. Trolleys:
   1. Motor driven, unless otherwise noted.
   2. Completely compatible with hoists, cranes, and monorails specified.
   3. Meet NEC standards according to classifications shown on Drawings.
   4. Minimum B-10 bearing life of 5000 HRS based on 75 percent of the wheel load, excluding impact.
   5. Motor Driven:
      a. Operate at a single speed as scheduled.
      b. Enclose internal gears in oil tight housing.
      c. Design motors to operate with 460 V, 3 PH, 60 cycle power supply.
   6. Plain trolleys:
      a. Frame consisting of thick rolled steel sections extending beyond wheel flanges to protect wheels.
      b. Alloy steel hardened axles, ball-bearings and pressed steel wheels.
         1) Carburized and hardened ball tread wheels.
         2) Factory lubricated requiring no additional lubrication.
      c. Bottom-running single flanged wheels of forged steel.

B. Hoists:
   1. Electric wire rope hoists:
      a. Duty cycle Classification H-1.
      b. Hoist frames of welded heavy steel plate construction.
      c. Oil tight gear casing for oil bath lubrication of gears.
      d. Construct rope drum and surrounding units to minimize abrading, crushing or jamming of the rope during usage.
      e. Drum diameter not less than 18 times the diameter of the rope used.
      f. Assure that two (2) complete wraps of rope remain on the drum after lowering the load hook through its lift distance, unless a lower limit device is provided, in which case provide a minimum of one (1) complete wrap.
      g. Double reeving for hoists with total lift height greater than hook height.
      h. Sheave and drum grooves shall be smooth and free from surface irregularities which could cause rope damage.
      i. Provide running sheaves with means for lubrication.
      j. Bearings:
         1) Antifriction type.
         2) Minimum B-10 life of 1250 HRS for Class H1, 2500 HRS for Class H2, and 5000 HRS for Class H3, based on full rated speed and mean effective load K of 0.65.

k. Mechanical load brake.
l. Lower limit switch to stop hoist when hook reaches its lower limit.
m. Motor:
1) Motor brake.
a) Internal disc magnetic type.
b) Rated for 150 percent of motor torque.
2) TENV motors operable on 460 V, 3 PH, 60 cycle power.
3) Meet specified area classification.
4) Permanently lubricate and seal motor ball-bearings.
5) Provide an upper limit switch to stop the hoist motor and apply the holding brake when the hook reaches its upper limit.
n. Controls:
1) Motor starters, electric conduit, control stations, magnetic reversing contactors and low-voltage transformer, necessary for a complete and totally functional conveying system.
o. Mark the hoist with the following information:
1) Name and address of manufacturer.
2) Manufacturer's unit identification number.
3) Rated load.
4) Voltage of AC or DC power supply and phase and frequency of AC power supply.
5) Rated amperage.

C. Bridge Crane Components:
1. See Specification Section 14305 - *Bridge Cranes*.

D. Provide and install a hoist and trolley at each location shown on the Drawings capable of lifting the capacity over the lift height shown in the Schedule below.

2.3 ACCESSORIES

A. Trolley stops designed to engage the trolley frame rather than trolley wheels.

B. Furnish chain containers for hand hoists.

C. Electrification and Controls:
1. Provide electrical power to the motor-driven hoists and trolleys using a festoon tag line system as follows:
a. Festoon tag-line system:
1) Equip with plastic wheels in areas with an NEC classification of Class I, Division 1 or 2, Group D.
2) Include all components needed for a complete and operable system.
2. Controls:
a. Pendant push-button control stations with reversing type contactors for electric hoists and/or trolleys, including bridge crane end trucks.
b. Single station if hoist and trolley are both motor-driven.
c. For trolleys directly supporting hoists, suspend control stations from trolleys. For crane end trucks, provide stationary, wall mounted control station.
d. Clearly mark function of each button.
e. Suspend station in a manner that will protect the electrical conductors against strain.
f. Control station shall be operable from 115 V power supply provided via control transformer mounted on trolley or end truck(s).
g. Ground control station to hoist.
h. Provide control cable lengths to within 4 FT of nearest floor.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Arrange supports for easy removal of track for repair or replacement.

B. Align track true and level.

C. Warning Signs:

1. Affix to the hoist or the lower load block or the controls in a readable position a durable label or labels displaying the following information concerning safe operating procedures:
   a. The word WARNING or other legend designed to bring the label to the attention of an operator.
   b. Cautionary language against:
      1) Lifting more than rated load.
      2) Operating hoist when hook is not centered under hoist.
      3) Operating hoist with twisted, kinked or damaged rope or chain.
      4) Operating damaged or malfunctioning hoist.
      5) Operating hoist with a rope that is not properly seated in its groove (if applicable).
      6) Lifting people or lifting loads over people.
      7) Removing or obscuring warning label.

3.2 FIELD QUALITY CONTROL

A. Test each hoist, trolley, and monorail using 110 percent rated load.

B. Employ and pay for services of equipment manufacturer's field service representative(s) to:

1. Inspect equipment covered by these Specifications.
2. Supervise pre-start up adjustments and installation checks and all field tests.
3. Conduct initial start up of equipment and perform operational checks.
4. Provide a written statement that manufacturer's equipment has been installed properly, started and is ready for operation by Owner's personnel.
5. Instruct Owner's personnel for 4 HRS at job site on operation and maintenance of the hoist, trolley, monorail and crane equipment.

3.3 SCHEDULE

A. Hoist, trolley, and monorail systems include but are not necessarily limited to the following:

Location	Tag Number	Loading (Tons)	Hoist	Trolley	Hook Height (FT)*	Lifting Height (FT)*	Lifting Speed FPM
Energy Recovery	H2	1½	C	HG	6'-0"	11'-0"	
Chlorine Room	H3	1	WR,EH	ET	10'-6"	10'-6"	
Intermediate PS	H4	4	WR,EH	ET	10'-6"	10'-6"	

*Distances listed are approximate as they will vary depending on hoist and trolley selection

PT = Plain Trolley
ET = Electric Trolley
C = Chain
WR = Wire Rope
HG = Hand Geared
EH = Electric Hoist
NA = Not Applicable

END OF SECTION

SECTION 14305

BRIDGE CRANES

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SECTION 14305

BRIDGE CRANES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hand geared and electric top-running bridge crane and trucks.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 14301 - *Hoists, Trolleys, and Monorails.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Gear Manufacturers Association (AGMA).
   2. American Welding Society (AWS).
   3. Crane Manufacturers Association of America, Inc. (CMAA):
      a. 70, Specifications for Electric Overhead Traveling Cranes.
      b. 74, Specifications for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist.

B. Qualifications:
   1. Welding shall be done by certified welders and shall be in accordance with the AWS standards.

C. Coordinate installation to assure proper operation within the confines dictated by structural, equipment, mechanical and electrical installations.

D. Verify hook and lifting heights for each application to assure each system is completely operational over range intended.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Girder layout including supports, connections and appurtenances.
   3. Load test results.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Bridge cranes:
      a. Gorbel.
      b. Acco.
      c. P&H.
      d. Columbus-McKinnon/Lockerail.

e. DeShazo.
f. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution*.

2.2 MANUFACTURED UNITS

A. Performance and Configuration Requirements:
1. Duty cycle rating: Class B.
2. Type: Internal-running, single girder, dual-drive electric. Direct drive end trucks.
3. Rated capacity: 4 TONS.
4. Span: See Drawings.
5. Crane overhead clearance: 3 IN minimum to nearest obstruction.

B. Design load carrying parts, except structural members and gears, so that the calculated stress in the material, based on rated load, shall not exceed 20 percent of the published average ultimate strength of the material.

C. Comply with CMAA #70 and #74.

D. Trolley and hoist (Section 14301 - *Hoists, Trolleys, and Monorails*) compatible with the specified bridge crane.

E. Runway Rails:
1. W-section or S-section steel beams for top-running end tracks.
2. Straight, parallel and level.
3. Sufficient strength and rigidity to prevent detrimental lateral or vertical deflection.

F. Bridge Girder:
1. W-section or S-section steel beam for bottom-running hoist trolleys.
2. Design girder to resist vertical, lateral and torsional forces and stresses as defined by CMAA #74.
3. The maximum vertical deflection of the girder produced by the dead load, weight of the trolley and hoist and the rated load shall not exceed 1/600 of the span.
4. Locate safety stops at each end of bridge girder to prevent overtravel of trolley hoist.

G. End Trucks:
1. Carry crane bridge on end trucks sized to carry the rated load when it is lifted at one end of the crane bridge.
2. End truck wheelbase minimum required to prevent bridge binding.
3. One end truck per pair shall allow the bridge to move to account for runway misalignments.
4. Construct from stamped steel body, non-articulating type.
5. Assure proper alignment of axles.
6. Design so that drop of truck is limited to 1 IN in case of axle or wheel failure.

H. Crane Wheels:
1. Suited for use with the internal bridge rail and runway.
2. Composite materials, Duracomp rails 4, or equal.
3. Factory lubricate and seal bearings.
4. Replaceable in the field without having to replace the entire trolley.

I. Crane Drives:
1. Provide each end truck with a helical gear motor reducer.
2. Motors integral with fully-enclosed oil splash lubricated gear reducers.
3. Support gear reduction shaft by precision ball or roller bearings.
4. Design motors and drives to supply the crane speed specified.
5. Permanently lubricate and seal motor ball-bearings.

J. Bearings: 5000 HRS B-10.

K. Gearing:
1. All gearing except the final reduction at the wheels shall run in oil or be splash lubricated.
2. Comply with AGMA specifications for load ratings.
3. Gears not enclosed in gear boxes.
   a. Safety guards.
   b. Provisions for lubrication and inspection.

L. Bridge Brake:
1. Capable of stopping bridge within a distance in feet equal to 10 percent of full load speed (in fpm) when traveling at full speed with full load.

M. Bumpers and Stops:
1. Capable of stopping the crane at a rate of deceleration not to exceed three feet per second when traveling in either direction at 20 percent of rated speed.
2. Sufficient energy absorbing capacity to stop the crane when traveling at full speed with full load.
3. Stops designed to resist full load speed.
4. Locate stops at limit of bridge travel.
5. Runway stops shall not engage wheel treads.

N. Electrical:
1. Provide disconnect device mounted on crane with overcurrent protection for the controllers.

2.3 ACCESSORIES

A. Electrification and Controls:
1. Provide electrical power to the motor-driven hoists and trolleys using festoon tag-line system:
   a. Equip with plastic wheels in areas with an NEC classification of Class 1, Division 1 or 2, Group D.
   b. Include all components needed for a complete and operable system.
2. Controls:
   a. Pendant push-button control stations with reversing type contactors for electric hoists and/or trolleys.
   b. Single control station to hoist and trolley.
   c. Suspend control stations from trolleys.
   d. Clearly mark function of each button.
   e. Suspend station in a manner that will protect the electrical conductors against strain.
   f. Control station shall be operable from 115 V power supply, derived from control transformer mounted on trolley.
   g. Ground control station to hoist.
   h. Provide control cable lengths of 1 FT less than distance to nearest floor.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install runway rails with center-to-center distance and elevation within 1/8 IN.

B. Warning Signs:
1. Maximum 10 FT intervals along rails with electrical conductors.
2. At stairs or ladders located 6 FT or less from the rail(s).
3. Warning sign legend and colors:
   a. DANGER (red).

b. HIGH VOLTAGE (black).
c. 480 V AC (black).
d. KEEP OFF (red).

3.2 FIELD QUALITY CONTROL

A. Test each crane using 110 percent rated load.

B. Employ and pay for services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.
2. Supervise pre-start up adjustments and installation checks and all field tests.
3. Conduct initial start up 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.
5. Instruct Owner's personnel for 4 HRS at job site on operation and maintenance of the hoist, trolley, monorail and crane equipment.

END OF SECTION

SECTION 14420

WHEELCHAIR LIFTS

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SECTION 14420

WHEELCHAIR LIFTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Vertical wheelchair lifts.

B. Related Sections include the following:
   1. Refer to Drawings for electrical service to lifts, including fused disconnect switches.

1.3 SUBMITTALS

A. Product Data: For each type of lift indicated. Include rated capacities, dimensions, performances, operations, safety features, controls, and finishes.

B. Shop Drawings: For each lift. Include plans, elevations, sections, details, and attachments to other Work. Indicate loading on structure and required clearances.

C. Samples: For each type of exposed finish and for control devices; 3 inches (75 mm) square for sheet materials; and 4 inches (100 mm) long for running-trim members.

D. Certificates and Permits: Provide Owner with inspection and acceptance certificates and operating permits, as required by authorities having jurisdiction, for normal, unrestricted use of lifts.

E. Maintenance Data: For each type of lift to include in maintenance manuals. In addition to items specified in for Operation and Maintenance Manual, include parts list with sources indicated and recommended parts inventory list.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Lift manufacturer or a qualified installer approved by lift manufacturer who has completed lift installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Regulatory Requirements: In addition to requirements of authorities having jurisdiction, comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts Fittings."

1.5 WARRANTY

A. Manufacturer shall warrant the wheelchair lift's drive system for a period of two years after Substantial Completion and all other components for one year after Substantial Completion.

1.6 MAINTENANCE SERVICE

A. Continuing Maintenance Service: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 OPERATION

A. The vertical wheelchair lift shall fully comply with ADA, ADAAG-SLGF, UFAS, and ANSI A117.1 latest editions for ease of operation. No special knowledge shall be reguired for operation of the lift. Written instructions shall be prominently posted on the lift.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Porch-Lift® vertical platform lift model PL-TG (toe guard) manufactured by ThyssenKrupp Access. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Garaventa (Canada) Ltd.: Model Genesis Opal.
   2. National Wheel-O-Vator Co., Inc. (The): Model BC-60.
   3. Ram Manufacturing LTD: Model Trus-T-Lift 5200.
   4. Or approved equal.

2.2 MATERIALS

A. Machine Tower: 14 ga. steel sheet.

B. Guide Rail: 3" x 2" x 1/8" ASTM A500 grade B steel tubing.

C. Base Frame: 2" x 2" x 1/4" structural steel tubing and angle.

D. Lift Weldment: 3/8" hot rolled steel plate and 2" x 2" x 1/4" wall structural steel tubing.

E. Side Guard Panels: 18 ga. galvanealed steel sheet in 1" x 2" x 14 ga. steel tubing frame.

F. Enclosure: 18 ga. galvanealed steel sheet in 1" x 2" x 14 ga. steel tubing frame.

G. Front Access Panel: 20 ga. galvanealed steel sheet.

H. Platform: 11 ga. steel plate.

I. Access Ramp: 11 ga. steel plate.

2.3 VERTICAL WHEELCHAIR LIFTS

A. System Description:
   1. Drive: AC powered ballscrew drive; 1/2 hp, 120 V, 60Hz, instant reversing motor.
   2. Number of Stops: Two.
   3. Platform Configuration: straight-thru.
   4. Maximum Travel: 52"
   5. Rated Load: 750 lbs. with minimum safety factor of 5X.
   6. Rated Speed: 9-12 fpm with rated load.
   7. Platform Size: 36" x 60" with 42" high guard panels.
   8. Enclosure: 56" high wall panels.
   9. Main Power Supply Wiring: Electrical contractor shall provide 115 VAC, single phase, 20 amp, 60 Hz power circuit.

B. Operating Features:
   1. Platform Controls: Directional paddle switch, on/off key switch, emergency stop switch with alarm and illuminated alarm button.
   2. Landing Controls: Directional paddle switch and on/off key switch mounted inside gate/door frames.
   3. Constant pressure operation.

4. Grounded electrical system with upper, lower and final limit switches and 24 V operating controls.
5. Ramp with incline of 1:12.
6. Non-slip surface on platform floor and ramp.
7. Grab rail on platform.
8. Manual lowering device.
9. Integral ballscrew safety device and electromechanical brake.
10. Upper Landing Gate/Door: 42" high, self-closing gate with VDR™ mechanical interlock and steel sheet insert panel.
11. Platform Gate: 42" high, self-closing gate with VDR™ mechanical interlock and steel sheet.
12. Lower Landing Gate: 53" high, self-closing gate with VDR™ mechanical interlock and steel sheet.
13. Automatic Gate/Door openers.

2.4 FINISHES

A. Components shall be prepared with:
   1. Alkaline detergent wash.
   2. Clear water rinse.
   3. Iron phosphate coating.
   4. Clear water rinse and finished with electrostatically applied and baked thermostatic powder coat finish for indoor or outdoor use. Color shall be selected by Architect from a full range of special order colors.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine installation areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
   1. Enclose wiring within housings of units or building construction. Do not use conduit exposed to view in finished spaces.

B. Alignment: Coordinate runway gates with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway gates, sills, and gate frames.

C. Position sills accurately, raised slightly above adjoining floor surfaces to minimize intrusion of dirt and spillage into runway. Fill space under sills solidly with nonshrink, nonmetallic grout.

D. Adjust stops for accurate leveling at each landing, within specified tolerances.
   1. Leveling Tolerance: 1/4 inch up or down, regardless of load and direction of travel.

E. Lubricate operating parts of lift, including drive mechanism, guide rails, gates, safety devices, and hardware.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and governing regulations and agencies.

B. Operating Test: In addition to above testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops and other devices and signal equipment for accurate landings and operation of system.

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on lifts.

3.4 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operation, and daily maintenance of lifts. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete lift maintenance program.

B. Make a final check of each lift operation with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION

SECTION 15010

MECHANICAL: BASIC REQUIREMENTS

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SECTION 15010

MECHANICAL: BASIC REQUIREMENTS

1.1 SUMMARY

A. Section Includes:
   1. Mechanical equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - *Painting and Protective Coatings.*
   4. Section 11005 - *Equipment: Basic Requirements.*
   5. Section 13440 - *Instrumentation for Process Control: Basic Requirements.*
   6. Section 15090 - *Pipe Support Systems.*
   7. Section 15990 - *HVAC Systems: Balancing and Testing.*
   8. Division 16 - Electrical.

1.2 QUALITY ASSURANCE

A. Comply with requirements of Section 11005 - *Equipment: Basic Requirements.*

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 National Contractors 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 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

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 coordinations, 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 - Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.

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:

B. Submit request for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Unions:

1. Provide union between valves and connection to each item as required for making up or disconnecting piping. Install unions to facilitate removal of parts, equipment, fixtures, or 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. Drains:

1. Install drains on plumbing, heating, air conditioning, process or other piping, either as indicated or as required to permit complete drainage of systems. Use drain consisting of 3/4 IN globe valve with hose adapter. Where additional drains are required to drain low points of piping, use minimum of 6 IN length of nipple with valve which may drain that portion of piping only. Provide hose end valves on all piping 2½ IN, and larger and drain cocks on piping 2 IN and smaller.

2. Pipe drains from safety valves and other items where discharge is infrequent or have test levers over edge of equipment or as indicated. Install drains on copper piping with a male iron pipe adapter and threaded brass cap except where valve drains are required.
3. Regardless of pipe size, where drains are installed on piping over electrical equipment or over other piping on equipment where access to drain valve is difficult, pipe these drain valves to accessible location with hose bibb adapter such that system may be drained without damage to equipment insulation of finished spaces.
4. Coordinate work to avoid piping over electrical components (not rated NEMA 4 or better) or provide minimum 16 GA 316 stainless steel pans to protect the electric components. Slope and pipe these pans to drains.

C. Vents:
1. Pipe vents from pressure regulating devices in compliance with applicable codes.

D. Sleeves:
1. Furnish and install sleeves where required for installation of work under this Division, see Section 01800 - *Openings and Penetrations in Construction.*
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.

E. Pipes and Anchors:
1. Comply to requirements of Section 15090 - *Pipe Support Systems.*
2. Furnish and install pipe anchors as indicated, or as required to permit complete installation of system. Do not anchor piping to metal and plaster or gypsum wallboard partition walls.
3. Anchors of sufficient strength structural shapes and stainless steel rods with turnbuckles are acceptable unless detailed otherwise.
4. Provide hanger rod anchoring devices, installed in concrete, of hard metal type which do not depend on soft lead for their holding power.

F. Equipment Anchors:
1. Comply to requirements of Section 11005 - *Equipment: Basic Requirements.*

G. Thermometer Wells:
1. Install thermometer well (well only) adjacent to each point where temperature sensing device is required by control specifications. Provide test wells installed on piping of extension neck type and where piping schematics indicate thermometers.

H. Thermometer Pressure Test Points:
1. Coordinate, provide, and install thermometer wells and test points as required by Section 15990 - *HVAC Systems: Balancing and Testing.*
   a. Test points: Stations shall be "Pete's Plugs" as manufactured by Peterson Engineering Company of Richardson, Texas, or approved equal.
   b. Supply Owner with minimum six pressure gages and minimum six testing thermometers (provide two each for each temperature pressure range listed in paragraph thermometers and pressure gages) for use with "Pete's Plugs."
2. Provide accessible self-closing thermometer or static pressure probe insertion points in unit casings or duct work. Provide at both entrance and discharge of heat transfer surfaces as shown on Drawings or required for test and balancing and designed for use with portable instrument in testing system.

I. Thermometers:
1. Number, location, and type of thermometers may be shown on Drawings or specified under equipment, piping or control specifications. Furnish and install industrial thermometers suitable for temperature measurement of liquid or air.

2. Remote reading thermometers: Furnish and install remote reading thermometers in locations indicated. Construct unit with gasket sealed heavy molded glass cover to a stainless steel case, ring, connecting tube and bulb.
   a. Provide thermometers with fully compensated case and remote tubing of length up to 150 FT.
   b. Provide a mercury filled temperature sensing bulb with connecting tubing to thermometer in location indicated. Furnish braided stainless steel armor for tubing.
   c. Calibrate unit at job site for pressure and temperature in accordance with manufacturer's instructions. Provide cases with external adjustment.
   d. Provide with 5 IN dial, range and graduation as described.
   e. Provide thermometer for adjustable wall mounting or for flush mounting in panels as application dictates.
3. Adjustable stem direct-drive thermometer. Furnish with direct connected stainless steel tapered bulb chamber, swivel nut and external neck for application not requiring remote dials. Provide of the same quality and features as remote reading type above.
4. Thermometers consist generally of, but are not limited to the following:

Service	Range °F	Graduation °F
Domestic hot water	0 - 250	2
Domestic cold water	30 - 130	1
Heating-hot water	50 - 300	2
Compressed air	50 - 300	2
HVAC Air Stream	-40 - 150	1

J. Pressure Gages:
1. Use gages conforming to ANSI specifications. Identify each gage with tag.
2. Use pressure gages suitable for service intended. Install siphons in accord with gage manufacturer's recommendations and best practices of trade.

K. Electric Wiring, Motors and Controls:
1. Comply to requirements of Section 11005 - *Equipment: Basic Requirements*, Section 13440 - *Instrumentation for Process Control: Basic Requirements*, 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 surfaces and leave in as good condition as existed prior to start of work.
6. Fireproofing repair: Install hangers, inserts, supports, anchorages, etc., prior to installation of fireproofing materials. Do not remove or damage fireproofing on roof deck, roof beams, roof framing, floor beams, floor framing members, columns, or wind bracing during installation of mechanical work. If fireproofing is damaged or is

removed, repair or replace to satisfaction of Engineer and at no additional expense to Owner.

B. Installation of Equipment:
   1. Comply to requirements of Section 11005 - *Equipment: Basic Requirements.*
   2. Use galvanized structural steel in all areas unless otherwise specified.
   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.
   2. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, strainers, traps, cleanouts, motors, and equipment and piping requiring service.
   3. Size of access panels to allow inspection and removal of items served, minimum 12 IN x 12 IN size. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or galvanized after fabrication and fitted with screw driver lock of cam type. Provide with key locks, keyed alike, in public use areas. Furnish panels with prime coat of paint. Style and type as required for material in which door installed. Where door is construction, provide door bearing UL label required for condition.

E. Painting:
   1. See Section 09905 - *Painting and Protective Coatings.*
   2. If factory finish on equipment is damaged in shipment or refinish equipment to satisfaction of Engineer.

3.2 FIELD QUALITY CONTROL

A. Balancing and Performance Tests:
   1. Comply with Section 15990 - HVAC Systems: Balancing and Testing.
   2. On date predetermined and agreed upon by manufacturer, Engineer, and Installer, prior to acceptance of installation by Owner, conduct various tests witnessed by Engineer to determine operational and functional acceptability of equipment installed. Tests will determine that items of equipment and materials installed fully meet requirements as to type, quality, design, and performance as stipulated in Contract Documents. If any work performed or any equipment furnished and installed is found to be defective take remedial measures and arrange for new tests at no extra cost to Owner. If, after retests, installation is still found to be inadequate, remove defective equipment and reinstall equipment of operational adequacy to satisfy Engineer that Contract Documents have been satisfied. Perform this work at no additional cost to Owner.

END OF SECTION

SECTION 15060

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

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SECTION 15060

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Process piping systems.
2. Utility piping systems.
3. Plumbing piping systems.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 02221 - *Trenching, Backfilling, and Compacting for Utilities.*
4. Section 09905 - *Painting and Protective Coatings.*
5. Section 10400 - *Identification, Stenciling, and Tagging Systems.*
6. Section 11005 - *Equipment: Basic Requirements.*
7. Section 13440 - *Instrumentation for Process Control: Basic Requirements.*
8. Section 13442 - *Primary Elements and Transmitters.*
9. Section 15090 - *Pipe Support Systems.*
10. Section 15100 - *Valves: Basic Requirements.*
11. Section 15183 - *Pipe, Duct, and Equipment 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.
   h. NSF/ANSI 61 Drinking Water System Components - Health Effects
   i. ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other Liquids.
   j. ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.
   k. ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand-Lined Molds for Water or Other Liquids.
   l. ANSI/AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
   m. ANSI/AWWA C140, Standard for Cement Mortar Lined Ductile Iron Pipe and Fittings.
2. American Society for Testing and Materials (ASTM):
   a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
   c. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
   d. A269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   e. A312, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
   f. A518, Corrosion-Resistant High-Silicon Cast-Iron.
   g. A536, Standard Specification for Ductile Iron Castings.

h. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
i. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
j. B88, Seamless Copper Water Tube (ANSI H23.1).
k. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
l. C76, Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
m. C443, Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible, Watertight, Rubber Gaskets.
n. D1785, Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
o. D2466, Socket Type (PVC) Plastic Pipe Fittings, Schedule 40.
p. D2467, Socket Type (PVC) Plastic Pipe Fittings, Schedule 80.
q. D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
r. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
s. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals.
t. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
u. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.
v. F438, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
w. F439, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
x. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

3. American Water Works Association (AWWA):
   a. B300, Standard for Hypochlorites.
   b. ANSI/AWWA C111/A21.11, 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. C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.
   g. C606, Grooved and Shouldered Joints.
   h. C651, Standard for Disinfecting Water Mains.
   i. C600, Installation of Ductile Iron Water Mains and their Appurtunances.
   j. C605, Underground Installation of PVC Pressure Pipe and Fittings for Water.
4. National Fire Protection Association (NFPA).
5. Underwriters Laboratory, Inc. (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

A. Hazardous Gas Systems: Chlorine gas.

1.4 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		
Symbol	Service	System
BW	Backwash	1
BWD	Backwash Drain	1
CA	Compressed Air	11
Carbon	Powered Activated Carbon	7
Caustic	Caustic	7
CDR	Chemical Drain	7
CLG	Chlorine Gas	7
CLS	Chlorine Solution	7
DR	Drain	1
PW	Potable Water	7
FE	Filter Effluent	1
FSA	Hydrofluosilicic Acid	7
FTW	Filter to Waste	1
FW	Finished Water	26
LPA	Low Pressure Air	12
$NaMnO_4$	Sodium Permanganate	7
NPW	Non-Potable Water	7
OF	Overflow	1
PACL	Poly Aluminum Chloride (Coagulant)	
POLY	Polymer	7
RL	Rain Leader	21
RW	Raw Water	1
SMP	Sample	10
SE	Sedimentation Effluent	1
SOL	Solution	7
Spare	Spare Piping	7
SU	Sump Discharge	1
SD	Storm Drain	8
SW	Seal Water	9
TMP	Temporary Piping	7
VENT	VENT	1
VT	Chemical Vent	7

3. See PIPING SPECIFICATION SCHEDULES in PART 3.

1.5 SUBMITTALS

A. Shop Drawings:

1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
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) Acknowledgment 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.
   b. Interior piping drawings (minimum scale 1/8 IN equals 1 FT) with information including:
      1) Dimensions of piping from column lines or wall surfaces.
      2) Centerline dimensions of piping.
      3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination
      4) Location and type of pipe supports and anchors.

5) Locations of valves and valve actuator type.
6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
7) Acknowledgment of valve, equipment and instrument tag numbers.
8) Provisions for expansion and contraction.
9) Line slopes and air release vents.
10) Rough-in data for plumbing fixtures.

c. Schedule of interconnections to existing piping and method of connection.

3. Product technical data including:
   a. Acknowledgment that products submitted meet requirements of standards referenced.
   b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
   c. Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components. Attach technical product data on gaskets, pipe, fittings, and other components, including pressure rating of flanges, gaskets, and fittings.
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 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

1.6 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.
      b. Or approved equal.
   2. Dirt strainers (Y-type):
      a. Mueller (#351).
      b. Sarco.
      c. Armstrong.
      d. Or approved equal.
   3. Chemical strainers (Y-type):
      a. Chemtrol.
      b. Asahi.
      c. Or approved equal.
   4. Dry disconnect couplings:
      a. Kamlock.
      b. Or approved equal.

5. Dielectric flange kit:
   a. PSI.
   b. Maloney.
   c. Central Plastics.
   d. Or approved equal.
6. Pipe saddles (for gage installation):
   a. Dresser Style 91 (steel and ductile iron systems).
   b. Dresser Style 194 (non-metallic systems).
   c. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution*.

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°F.
      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°F.
      c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Strainers for Chemical Applications:
   1. Y-type.
   2. Strainers of same material, test pressure, and temperature rating as system in which strainer is placed.

C. 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.

D. 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 Section 09905 - *Painting and Protective Coatings*.
   3. All linings shall comply with NSF-61.

E. Underground Warning Tape:
   1. See Section 10400 - *Identification, Stenciling, and Tagging Systems*.

F. Pressure Gages:
   1. See Section 11005 - *Equipment: Basic* Requirements and Section 13442 - *Primary Elements and Transmitters*.

G. Dry Disconnect Couplings:
   1. Adapters:
      a. Male adapters: Size shown on Drawings.
      b. Adapters:

1) Female NPT end connection for sludge and flush applications.
2) Male NPT end connection for chemical applications.

c. Construct adapters for sludge applications from cast iron or steel.
d. Construct adapters for chemical and PVC system applications 3 IN and below from polypropylene. Above 3 IN size, provide stainless steel units.

2. Couplers:
   a. Built-in valve and spring loaded poppet which close automatically when disconnected.
   b. Designed to remain with only one arm locked in closed position.
   c. Construct couplers for sludge applications fabricated from material utilized for adapters.
   d. Construct couplers for chemical and PVC system applications 3 IN and less from polypropylene with stainless steel arms and pins. Above 3 IN, provide stainless steel units.
   e. Gasket: Compatible with conveyed liquid.
3. Dust caps: For all adapters.

H. Valves:
1. See schematics and details for definition of manual valves used in each system under 4 IN in size. See Section 15100 - *Valves: Basic Requirements* schedule for valve types 4 IN and above and for automatic valves used in each system.
2. See Section 15100 - *Valves: Basic Requirements*.

I. Flexible Coupling Adaptors:
1. Provide flexible connector suitable for pressure requirements of attached piping.
2. Provide manufacturer certification that materials in contact with process water are NSF-61 approved.
3. Unaflex Style 200 (XL), FPM material (300 psi piping).
4. Redflex J1 Expansion Joint (<200 psi).

J. Health Effects:
1. All components in contact with fluid shall comply with NSF-61.

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. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Section 01800 - *Openings and Penetrations in Construction* and as shown on Drawings.

C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure. Install second joint not more than 6 FT or less than 4 FT from first joint.

D. Install expansion devices as necessary to allow expansion and contraction movement.

E. Laying Pipe in Trench:
1. Excavate and backfill trench in accordance with Section 02221 - *Trenching, Backfilling, and Compacting for Utilities*.
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.

F. 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.

G. 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.
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.
4. Precast thrust blocks shall not be utilized.

H. Install underground hazard warning tape per Section 10400 - *Identification, Stenciling, and Tagging Systems*.

I. Install insulating components where dissimilar metals are joined together.

3.2 CONTAINMENT PIPING

A. Required for the following pipe systems:
1. PACL
2. NaMn04
3. HSA
4. Caustic
5. SMP

B. Containment Types
1. Interior Piping - Required everywhere outside of tank containment areas, and in tank containment areas everywhere the piping is 6-feet or higher above FFE)
a. May be either of two types:
1) Commercial Double Contained Piping System
a) Must contain at least 4' section of clear exterior pipe for every 20' of piping
b) Clear section shall be installed at lowest point of piping, including at fittings
c) Interior pipe shall meet pipe system requirements. Exterior pipe may be PVC, CPVC, PVDF, or Polypropylene
d) Containment drain shall be installed per the drawings
e) All valves shall be contained with the manufacturer's standard containment valve
f) Acceptable Manufacturers:
(1) Flosafe
(2) Chemtrol
(3) Asahi-America
2) Schedule 40 PVC with Carrier Pipe
a) Must contain at least 4' section of clear exterior PVC for every 16' of piping
b) Clear section shall be installed at lowest point of piping, including at fittings
c) Carrier pipe and tubing shall meet pipe system requirements

d) Install containment drain per the drawings
e) End containment 1' on either side of any interior valves, including anti-siphon valves.
f) Install containment pipe as required for System 7
g) Containment pipe shall be minimum 2" larger in diameter than carrier pipe, 4-inches minimum.

2. Exterior below Grade Piping
   a. Schedule 80 PVC with Carrier Tubing
   b. All piping to be run with tubing which is meant to be removed if plugged
   c. Provide one length of tubing for entire exterior contained run, no fittings or tubing connections underground will be allowed.
   d. Tubing shall be clear polypropylene with a minimum working pressure of 87 psi, Prolite or equal.
   e. Containment pipe size shall be minimum 2" larger in diameter than tubing called for, minimum size 4".
   f. Install containment piping as required for System 7.

3.3 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 IN may not be shown. However, install according to Drawing intent and with clearance and allowance for:
   1. Expansion and contraction.
   2. Operation and access to equipment, doors, windows, hoists, moving equipment.
   3. Headroom and walking space for working areas and aisles.
   4. System drainage and air removal.

C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Section 01800 - *Openings and Penetrations in Construction* and as shown on the Drawings.

D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

E. Pipe Support:
   1. Use methods of piping support as shown on Drawings and as required in Section 15090 - *Pipe Support Systems*.
   2. Piping support systems for piping 24 IN and greater are shown on the Drawings. Support systems for piping smaller than 24 IN DIA are not shown on the Drawings. Contractor is responsible for design of these support systems per Section 15090 - *Pipe Support Systems*.
   3. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
   4. Size pipe supports with consideration to specific gravity of liquid being piped.

F. Locate and size sleeves and castings required for piping system. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

G. Use reducing fittings throughout piping systems. Bushings will not be allowed unless specifically approved.

H. Equipment Drainage and Miscellaneous Piping:
   1. Provide drip pans and piping at equipment where condensation may occur.
   2. Hard pipe stuffing box leakage to nearest floor drain.
   3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
      a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.

b. Hard pipe drainage to nearest floor drain.

4. Collect system condensate at drip pockets, traps and blowoff valves.
5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings. Size to handle application with 3/4 IN being minimum size provided.

I. Unions:

1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

J. Install expansion devices as necessary to allow expansion/contraction movement.

K. Provide full face gaskets on all systems.

L. Anchorage and Blocking:

1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

M. Equipment Pipe Connections:

1. Equipment - General:
   a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
   b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
   c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint. Provide tightening torque in accordance with manufacturer's recommendations.
   d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
   e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
   g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
   h. To provide maximum flexibility and ease of alignment, 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.
   i. Provide flanged coupling adapter or flexible connector on suction and discharge of blowers and pumps.
2. Plumbing and HVAC equipment:
   a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
   b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.

c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve. Provide wheel handle stop valve at each laboratory sink water supply. Minimum size to be 1/2 IN.
d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system. Size trap as required by Plumbing Code.
e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

N. Provide insulating components where dissimilar metals are joined together.

O. Gages:
1. Assure gage position is clear of equipment functions and movements and location is protected from maintenance and operation of equipment.
2. Assure gage is readable from an accessible standing position.
3. Tap piping 4 IN and larger and all non-metallic pipe for gage installation.
4. For piping to 4 IN, utilize tee with branch reduced for gage.

3.4 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.

H. Field measure all existing piping to be replaced to assure proper fix-up.

3.5 PRESSURE GAGES

A. Provide at locations shown on the Drawings and specified.

B. See Section 11005 - *Equipment: Basic Requirements.*

3.6 FIELD QUALITY CONTROL

A. Pipe Testing - General:
1. Test piping systems as follows:
a. Test exposed, non-insulated piping systems upon completion of system.
b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.

2. Utilize pressures, media and pressure test durations as specified on Piping Specification Schedules.
3. Isolate equipment which may be damaged by the specified pressure test conditions.
4. 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 the Engineer 24 HRS prior to each test.
5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:

1. Testing medium: Unless otherwise specified in the Piping Specification Schedules, utilize the following test mediums.
   a. Process and plant air systems:

Pipe Line Size	Specified Test Pressure	Testing Medium
2 IN and smaller	75 psi or less	Air or water
2 IN and smaller	Greater than 75 psi	Water
Greater than 2 IN	3 psi or less	Air or water
Greater than 2 IN	Greater than 3 psi	Water

   b. Laboratory gases and natural gas systems: Cylinder nitrogen.
   c. Liquid systems:

Pipe Line Size (DIA)	Gravity or Pumped	Specified Test Pressure	Testing Medium
Up to and including 48 IN	Gravity	25 psig or less	Air or Water
Above 48 IN	Gravity	25 psig or less	Water
All sizes	Pumped	250 psig or less	Water

2. Allowable leakage rates:
   a. All exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage at the specified test pressure throughout the duration of the test, as specified for the individual system.
   b. All buried piping shall be tested, after backfilling to a hydrostatic pressure of not less than that specified for the relevant system, and shall follow the relevant procedures as described in AWWA C600 and AWWA C605. Allowable leakage shall be as follows:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where: L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of pipe in inches
P = average test pressure during leakage test in psi

   c. Hydrostatic exfiltration and infiltration for sanitary and storm water sewers (groundwater level is below the top of pipe):
      1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.
      2) Average head is defined from groundwater elevation to average pipe crown.
      3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) = 115 x (actual test head to the 1/2 power).
   d. Hydrostatic infiltration test for sanitary and storm water sewers (groundwater level is above the top of pipe):
      1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 FT to 6 FT.

2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) = 82 x (actual head to the 1/2 power).

e. Non-hazardous gas and air systems which are tested with air shall have a maximum pressure drop of 5 percent of the specified test pressure throughout the duration of the test.

f. For low pressure (less than 25 psig) air testing, the acceptable time for loss of 1 psig of air pressure shall be:

Pipe Size (In DIA)	Time, Minutes/100 FT
4	3:46
6	5:40
8	7:34
10	9:26
12	11:20
15	14:10
18	17:00
21	19:50
24	22:47
27	28:51
30	35:37

3. Hydrostatic pressure testing methodology:
   a. General:
      1) All joints, including welds, are to be left exposed for examination during the test.
      2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      3) Provide temporary restraints for expansion joints for additional pressure load under test.
      4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
      5) Do not paint or insulate exposed piping until successful performance of pressure test.
   b. Soil, waste, drain and vent systems:
      1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
      2) Eliminate leaks before proceeding with work or concealing piping.
      3) Minimum test heights shall be 10 FT above highest stack inlet.
4. Natural gas systems - testing methodology:
   a. Maintain specified test pressure until each joint has been thoroughly examined for leaks by means of soap suds and glycerine.
   b. Wipe joints clean after test.
5. Air testing methodology:
   a. General:
      1) Assure air is ambient temperature.
   b. Low pressure air testing:
      1) Place plugs in line and inflate to 25 psig.
      2) Check pneumatic plugs for proper sealing.
      3) Introduce low pressure air into sealed line segment until air pressure reaches 4 psig greater than ground water that may be over the pipe.
         a) Use test gage conforming to ANSI B40.1 with 0 psi to 15 psi scale and accuracy of 1 percent of full range.
      4) Allow two (2) minutes for air pressure to stabilize.
      5) After stabilization period (3.5 psig minimum pressure in pipe) discontinue air supply to line segment.
      6) Record pressure at beginning and end of test.
6. No pipe shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of pipe shall only be done after installation of all valves, taps, and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing of water mains shall be observed and documented by ENGINEER.

7. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.
8. After section of system under test has reached required pressure as stated above, said pressure shall be maintained for the duration specified for each individual system. At conclusion of pressure test, volume of makeup water displacement meter or by pumping from vessel of known volume.
9. All joints or fittings at which leakage occurs shall be reworded to ensure tightness. All visible leaks shall be repaired regardless of amount of leakage. If measured amount of leakage exceeds values for the appropriate size as found in AWWA Specification C600 or C605 and as specified here, pipeline shall be repaired and retested until leakage is within limit set by the referenced specification. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

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.

3.7 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
1. Clean interior of piping systems thoroughly before installing.
2. Maintain pipe in clean condition during installation.
3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
5. 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 which may have accumulated by operation of system, from testing, or from other causes. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
6. After erection of piping and tubing, but prior to installation of service outlet valves, blow natural gas {liquefied petroleum gas} and digester gas systems clear of free moisture and foreign matter by means of air, nitrogen or carbon dioxide. Oxygen shall never be used.
7. Clean chlorine gas piping by pulling a cloth saturated with trichlorethylene or other suitable chlorinated solvent through each length of pipe. Disassemble valves and clean with suitable solvent. All surfaces which may come in contact with chlorine gas shall be thoroughly dry and free of oil or grease before placing in service.

B. Disinfection of Potable Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
2. Perform work, including preventative measures during construction, in full compliance with AWWA C651. See Section 02660 - *Water Main Construction*.
3. Perform disinfection using sodium hypochlorite complying with AWWA B300.

3.8 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.

3.9 PIPE INSULATION

A. Insulate pipe and pipe fittings in accordance with Section 15183 - *Pipe, Duct, and Equipment Insulation.*

3.10 SCHEDULES

A. PIPING SPECIFICATION SCHEDULE - SYSTEM 1

1. General:
   a. Piping service:
      1) BW - Backwash.
      2) FE - Filter Effluent.
      3) FTW - Filter to Waste.
      4) DR - Drain.
      5) BWD - Backwash Drain.
      6) SD - Sump Discharge.
      7) SE - Sedimentation Effluent.
      8) VENT - Vent.
      9) OF - Overflow.
      10) RW - Raw Water.
      11) SU - Sump Discharge.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: 150 psig.
      3) Duration: 6 HRS.
   c. Gaskets:
      1) Flanged, push-on, and mechanical joints (ductile iron): Rubber, ANSI/AWWA C111/A21.11.
2. System components:
   a. Pipe size: 1 IN through 3 IN.
      1) Exposed service:
         a) Materials: Steel, Grade B, black. Schedule 40 if threaded. If grooved type joint, use pipe thickness per AWWA C606.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coating: Paint.
         e) Fittings: Malleable iron or steel meeting ANSI B16.3 and ASTM 234.
         f) Joints: Threaded or grooved type mechanical coupling (AWWA C606) joints. With both systems, provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.
      2) Buried service:
         a) Materials: Steel, Schedule 40, Grade B.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coating: Bituminous.
         e) Fittings: Malleable iron meeting ANSI B16.3.
         f) Joints: Threaded.
   b. Pipe size: 4 IN through 42 IN.
      1) Exposed service:
         a) Material: Ductile iron, Class 150 if flanged.
         b) References:
            (1) ANSI/AWWA C104/A21.4.
            (2) ANSI/AWWA C110/A21.10.

(3) ANSI/AWWA C115/A21.15.
(4) ANSI/AWWA C153/A21.53.
c) Lining: Cement.
d) Coating: Paint.
e) Fittings: ANSI/AWWA C110/A21.10 ductile or gray iron.
f) Joints: ANSI/AWWA C115/A21.15 flanged joints. Provide screwed-on ductile iron flanges.

2) Buried service:
a) Materials: Ductile Iron, Pressure Class 150.
b) References:
(1) ANSI/AWWA C104/A21.4.
(2) ANSI/AWWA C110/A21.10.
(3) ANSI/AWWA C151/A21.51.
(4) ANSI/AWWA C153/A21.53.
c) Lining: Cement mortar.
d) Coating: Asphalt at standard thickness.
e) Fittings: ANSI/AWWA C110/A21.10 ductile or gray iron or ANSI/AWWA C153/A21.53 ductile iron compact Fittings for sizes 3 to 12 IN.
f) Joints: Push-on joints with mechanical joints at fittings and valves.

B. PIPING SPECIFICATION SCHEDULE - SYSTEM 2 - NOT USED.

C. PIPING SPECIFICATION SCHEDULE - SYSTEM 3 - NOT USED.

D. PIPING SPECIFICATION SCHEDULE - SYSTEM 4 - NOT USED.

E. PIPING SPECIFICATION SCHEDULE - SYSTEM 5 - NOT USED.

F. PIPING SPECIFICATION SCHEDULE - SYSTEM 6 - NOT USED.

G. PIPING SPECIFICATION SCHEDULE - SYSTEM 7

1. General:
a. Piping symbol and service:
1) TMP - Temporary Piping.
2) FSA - Hydrofluorosilici Acid.
3) Carbon - Powdered Activated Carbon.
4) CLS - Chlorine Solution.
5) POLY - Polymer.
6) .PW - Potable Water.
7) Caustic - Caustic
8) CDR - Chemical Drain.
9) CLG - Chlorine Gas.
10) CLS - Chlorine Solution.
11) NsMn O_4 - Sodium Permanganate.
12) NPW - Non-potable Water.
13) PACL - Coagulant.
14) SOL - Solution.
15) Spare - Spare
b. Test requirements pressure lines:
1) Test medium: Water.
2) Pressure: 200 psig.
3) Duration: 6 HRS.
4) Ensure all air is removed from lines prior to testing.
c. Solvent Weld Cement:
1) LO-V.O.C. PVC Heavy Duty Cement - Industrial Grade by Oatey or equal.

2. System components:
a. Pipe size: Up to 3.5 IN.
1) All service:
a) Material: PVC, Type 1, Grade 1, Schedule 80.
b) Reference: ASTM D1785.
c) Lining: None.

d) Coating: Paint.
e) Fittings: Solvent welded socket type complying with ASTM D2467.
f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
g) Shall be marked with NSF-PW mark.
h) Bury metallic detection tape 6-12" below grade per Specification Section 10400.

b. Pipe size: 4-14 IN.
1) Exposed service:
a) Material: PVC, Type 1, Grade 1, Schedule 80.
b) Reference: ASTM D1785.
c) Lining: None.
d) Coating: Paint.
e) Fittings: Solvent welded socket type complying with ASTM D2467.
f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
g) Shall be marked with NSF-PW mark.
2) Buried service:
a) Material: AWWA C900 DR 25 PVC.
b) Reference: AWWA C900.
c) Lining: None.
d) Coating: None.
e) Fittings: AWWA C900.
f) Joints: Push-on joint with restraint at all fittings.
g) Bury metallic detection tape per Specification Section 10400.

H. PIPING SPECIFICATION SCHEDULE - SYSTEM 8
1. General:
a. Piping symbol and service:
1) SD - Storm Drain
b. Test requirements:
1) Test Medium: Water.
2) Pressure: 20 psi.
3) Duration: 3 hours.
c. Gaskets:
1) PVC piping -- elastomeric gasket joint, ASTM D3212 (Push-on joints: Neoprene).
2) Transition between ductile iron piping and PVC piping - gasket shall be specifically manufactured SDR 35 to ductile iron transition gaskets.
2. System components:
a. PVC Sewer: 4-12 IN.
1) Buried Service
a) Materials: PVC - cell classification 12454-B, or 12454-C, PS46 and SDR-35.
b) References: ASTM D1784, ASTM D3034, F679.
c) Lining: None.
d) Coating: None.
e) Joints: Integral bell, bell and spigot rubber gasketed joint. Between ductile and PVC pipe, use flanged or grooved type mechanical coupling joints.
f) Bury metallic detection tape per Specification Section 10400.

I. PIPING SPECIFICATION SCHEDULE - SYSTEM 9
1. General:
a. Piping symbol and service:
1) SW - Seal Water.
b. Test requirements:
1) Test medium: Water.
2) Pressure: 125 psig.
3) Duration: 6 HRS.
c. Gaskets and O-rings:
1) O-rings: Neoprene or rubber.

2) Flanged, push-on and mechanical joints (ductile iron): Rubber, ANSI/AWWA C111/A21.11.
3) Flanged joints (steel): Rubber, ANSI C207.
4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.

2. System components:
a. Pipe size: To 1 IN.
1) Exposed service:
a) Materials: Stainless steel tubing, TP-304L.
b) Reference: ASTM A269.
c) Lining: None.
d) Coating: Paint.
e) Fittings: Stainless steel 304L compression type tube fittings.
f) Joints: Compression type couplings, unions at equipment and valves.
g) Minimum wall thickness:
(1) 1/16 IN OD: 0.010 IN.
(2) 1/8 to 1/4 IN OD: 0.028 IN.
(3) 5/16 to 1/2 IN OD: 0.049 IN.
(4) 5/8 to 1 IN OD: 0.065 IN.

b. Pipe size: 1 to 3 IN.
1) Exposed service:
a) Materials: Steel, Grade B, black. Schedule 40 if threaded. If grooved type joint, use pipe thickness per AWWA C606.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Paint.
e) Fittings: Malleable iron or steel meeting ANSI B16.3 and ASTM 234.
f) Joints: Threaded or grooved type mechanical coupling (AWWA C606) joints. With both systems, provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.
2) Buried service:
a) Materials: Steel, Schedule 40, Grade B.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Bituminous.
e) Fittings: Malleable iron meeting ANSI B16.3.
f) Joints: Threaded.

c. Pipe size: 3 IN through 8 IN.
1) Exposed service:
a) Materials: Ductile iron, Class 53 if flanged. If grooved type mechanical joint system, use pipe thickness per AWWA C606.
b) Reference:
(1) ANSI/AWWA C104/A21.04. Cement.
(2) ANSI/AWWA C110/A21.10. Fittings.
(3) ANSI/AWWA C115/A21.15. Flanged.
(4) ANSI/AWWA C151/A21.51. Design.
(5) ANSI/AWWA C153/A21.53
(6) ANSI/AWWA C153/A21.53.
c) Lining: Cement.
d) Coating: Paint.
e) Fittings: ANSI/AWWA C110/A21.10 ductile or gray iron.
f) Joints: Flanged or grooved type mechanical coupling (AWWA C606) joints. With both systems, provide screwed-on flanges at valves, equipment and structure penetration.
2) Buried service:
a) Materials: Ductile iron, Pressure Class 350.
b) Reference:
(1) ANSI/AWWA C104/A21.04.
(2) ANSI/AWWA C110/A21.10.
(3) ANSI/AWWA C151/A21.51.
(4) ANSI/AWWA C153/A21.53.
c) Lining: Cement.
d) Coating: Bituminous.

e) Fittings: Either ANSI/AWWA C110/A21.10 ductile or gray iron. Optional ANSI/AWWA C153/A21.53 ductile iron compact fittings for sizes 3 to 16 IN.
f) Joints: Push-on with mechanical (stuffing box type) joint at fittings and valves.

J. PIPING SPECIFICATION SCHEDULE - SYSTEM 10

1. General:
   a. Piping symbol and service:
      1) SMP - Sample.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: 200 psig.
      3) Duration: 6 HRS.
2. System components:
   a. Pipe size: To 3 IN.
      1) Exposed service:
         a) Material: Copper tubing, Type L.
         b) Solder: Cadmium and lead-free solder compatible with tubing and fittings materials.
         c) Reference: ASTM B88.
         d) Lining: None.
         e) Coating: Paint.
         f) Fittings: Wrought copper or bronze fittings meeting ANSI B16.22.
         g) Joints: Soldered or brazed with unions at valves and equipment.
3. Potable Piping Installation:
   a. Install drain tees with capped nipples of IPS brass 3 IN long at low points. If low point occurs in concealed piping, provide approved flush access panel. These drains are not shown on Drawings.
   b. Slope water lines down to drain points not less than 1 IN in 60 FT.
   c. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs. Pipe joint cement permitted only on external threads.
   d. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
   e. Install unions between valves and connections to each piece of equipment, and install sufficient number of unions throughout piping system to facilitate installation and servicing. On copper pipe lines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2½ IN and over install brass flange unions.
   f. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
   g. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.
   h. Provide branches to wall hydrants or hose bibs in exterior locations with interior shutoff and drain valves.
   i. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.

K. PIPING SPECIFICATION SCHEDULE - SYSTEM 11

1. General:
   a. Piping symbol and service:
      1) Compressed Air.
   b. Test requirements:
      1) Test medium: See Article 3.06.
      2) Pressure: 200 psig.
      3) Duration: 6 HRS.
   c. Gaskets and O-rings:
      1) O-ring and flanged joints: Rubber or neoprene, 250°F.
      2) Grooved coupling joints (steel): AWWA C606, rubber, 250°F.
2. System components:

a. Pipe size: 3/8 IN and smaller.
   1) Exposed service: See Section 13440 - *Instrumentation for Process Control: Basic Requirements.*
b. Pipe size: To 1 IN and smaller.
   1) Exposed service:
      a) Material: Stainless steel tubing, 304L.
      b) Reference: ASTM A269.
      c) Lining: None.
      d) Coating: None.
      e) Fittings: Stainless steel 304L.Compression type tube fittings.
      f) Joints: Compression type couplings, unions at equipment and valves.
c. Pipe size: 1 IN to 4 IN.
   1) Exposed service:
      a) Materials: Steel, Grade B, black. Schedule 40 if threaded. If grooved type joint, use pipe thickness per AWWA C606.
      b) Reference: ASTM A53.
      c) Linings: None.
      d) Coating: Paint.
      e) Fittings: Malleable iron or steel meeting ANSI B16.3, STM A234.
      f) Joints: Threaded. Provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.

3. Exposed Plant and Instrument Air Piping Installation:
   a. Slope all piping mains approximately 1: 100 toward points of drainage.
   b. Provide driplegs at low points:
      1) Provide ball type isolation valve.
      2) Route dripleg to nearest wall or column and terminate 4 FT above finished floor.

L. PIPING SPECIFICATION SCHEDULE - SYSTEM 12

1. General:
   a. Piping symbol and service:
      1) LPA - Low Pressure Process Air.
   b. Test requirements:
      1) Test medium: Air.
      2) Pressure: 20 psig.
      3) Duration: 6 HRS.
   c. Gaskets and O-rings:
      1) O-rings and flanged joints: Neoprene, 250°F.
   d. Temperature:
      1) Normal: 200 - 225°F.
      2) Maximum: 250°F.
2. System components:
   a. Pipe size: Through 10 IN:
      1) Interior and Exterior Piping:
         a) Material: Stainless steel 304L, Schedule 5S
         b) Reference:
            (1) ASTM A778.
            (2) ASTM A312.
         c) Lining: None.
         d) Coating: None.
         e) Fittings: Seamless steel 304L meeting ASTM A774.
         f) Joints: Butt welded with flanges at equipment and valves. Harnessed compression sleeve couplings at both sides of wall penetrations and at equipment connections.
         g) Insulated per Section 15183 - *Pipe, Duct, and Equipment Insulation.*

M. PIPING SPECIFICATION SCHEDULE - SYSTEM 13 - NOT USED

N. PIPING SPECIFICATION SCHEDULE - SYSTEM 14 - NOT USED

O. PIPING SPECIFICATION SCHEDULE - SYSTEM 15 - NOT USED

P. PIPING SPECIFICATION SCHEDULE - SYSTEM 16 - NOT USED

Q. PIPING SPECIFICATION SCHEDULE - SYSTEM 17 - NOT USED

R. PIPING SPECIFICATION SCHEDULE - SYSTEM 18 - NOT USED

S. PIPING SPECIFICATION SCHEDULE - SYSTEM 19 - NOT USED

T. PIPING SPECIFICATION SCHEDULE - SYSTEM 20 - NOT USED

U. PIPING SPECIFICATION SCHEDULE - SYSTEM 21

1. General:
   a. Piping symbol and service:
      1) Rain Leader.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: 25 psig.
      3) Duration: 6 HRS.
   c. Gaskets: Rubber, ASTM C564.
2. System components:
   a. Pipe size: 1¼ and 1½ IN:
      1) Exposed service.
         a) Material: Galvanized steel, Schedule 40.
         b) Reference: ASTM 53.
         c) Lining: Galvanized.
         d) Coating: Paint.
         e) Fittings: Cast iron drainage.
            (1) ASTM A126, Class B.
         f) Joints: Threaded.
   b. Pipe size: 2 IN and larger:
      1) Exposed service.
         a) Material: Cast iron soil pipe.
         b) Reference: ASTM A74, CISPI 301.
         c) Lining: None.
         d) Coating: Paint.
         e) Fittings: ASTM A74.
         f) Joints: No-hub with elastomeric sealing sleeve and stainless steel clamp assembly conforming to CISPI 301.
      2) Buried service (to 5 FT outside of structure):
         a) Material: Cast iron soil pipe.
         b) Reference: ASTM A74.
         c) Lining: None.
         d) Coating: Bituminous.
         e) Fittings: ASTM A74.
         f) Joints: Hub and spigot.
      3) Buried service (beyond 5 FT outside of structure):
         a) Material: PVC Schedule 80.
         b) Reference: ASTM D1785.
         c) Lining: None.
         d) Coating: None.
         e) Fittings: ASTM D2467.
         f) Joints: Solvent Welded, Socket Type.
3. Soil and Waste Piping Installation:
   a. Install horizontal soil or waste lines less than 4 IN DIA with a slope of not less than 1/4 IN/FT or 2 percent toward the point of disposal.
   b. Install 4 IN and larger piping at 1/8 IN per foot.
   c. Install as close to construction as possible to maintain maximum head room.
   d. Make changes of direction with 1/8 bends and junctions with wye fittings.
   e. Use short wye fittings in vertical pipe only.
   f. Install handhole test tee at base of each stack.

g. Install cleanouts at dead ends, at changes of direction and at 50 FT intervals on horizontal runs. Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
h. Install piping true to grade and alignment. Begin at the system low point.
i. Locate vertical extensions of underground piping below partition walls for concealment in wall. In locations where hubs are wider than partition, set hubs 1 IN below final floor.
j. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.
k. For hub and spigot joints, install hub facing downstream.

4. Vent Piping Installation:
a. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
b. Originate each vent stack from soil or waste pipe at its base.
c. Where possible, combine soil, waste or vent stacks before passing through roof so as to minimize roof openings.
d. Offset pipes running close to exterior walls away from such walls before passing through roof to permit proper flashing.
e. Provide pipes passing through roofs with cast iron increasers minimum of 12 IN below roof one size larger than pipe but in no case less than 4 IN.
f. Terminate each vent with approved frostproof jacket.
g. Carry vent stacks 4 IN and larger full size through roof. Extend vent stacks at least 12 IN above roofing.
h. Pipe vents from pressure regulating devices in compliance with local codes.
i. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

V. PIPING SPECIFICATION SCHEDULE - SYSTEM 22 - NOT USED

W. PIPING SPECIFICATION SCHEDULE - SYSTEM 23 - NOT USED

X. PIPING SPECIFICATION SCHEDULE - SYSTEM 24 - NOT USED

Y. PIPING SPECIFICATION SCHEDULE - SYSTEM 25 - NOT USED

Z. PIPING SPECIFICATION SCHEDULE - SYSTEM 26

1. General:
a. Piping symbol and service:
1) FW - Finished Water.
b. Test requirements:
1) Test medium: Water.
2) Pressure: 350 psig.
3) Duration: 6 HRS.
4) Allowable leakage: None.
c. Gaskets:
1) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA C111.
2) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
3) Flanged joints (steel): Rubber, ANSI C207.
d. Dismantling Joints:
1) Flanged AWWA Class F, Ductile Iron or Steel.
2) Working Pressure: 300 psig.
3) Fasteners: Stainless Steel 316 per ASTM A193.
4) Romac Industries, Inc. Model DJ400 or approved equal.
e. Flexible Connectors:
1) Working pressure greater than or equal to 300 psig.
2) Material FPM.
3) Unaflex Style 200 (XL) or approved equal.

2. System Components:
a. Pipe size: To 1 IN.

1) Exposed service:
a) Materials: Stainless steel tubing, TP-304L.
b) Reference: ASTM A269.
c) Lining: None.
d) Coating: Paint.
e) Fittings: Stainless steel 304L compression type tube fittings.
f) Joints: Compression type couplings, unions at equipment and valves.
g) Minimum wall thickness (but all tubing must be rated for test pressure):
(1) 1/16 IN OD: 0.010 IN.
(2) 1/8 to 1/4 IN OD: 0.028 IN.
(3) 5/16 to 1/2 IN OD: 0.049 IN.
(4) 5/8 to 1 IN OD: 0.065 IN.

b. Pipe size: 1 to 3 IN.
1) Exposed service:
a) Materials: Steel, Grade B, black. Schedule 40 if threaded. If grooved type joint, use pipe thickness per AWWA C606.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Paint.
e) Fittings: Malleable iron or steel meeting ANSI B16.3 and ASTM 234.
f) Joints: Threaded or grooved type mechanical coupling (AWWA C606) joints. With both systems, provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.
2) Buried service:
a) Materials: Steel, Schedule 40, Grade B.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Bituminous.
e) Fittings: Malleable iron meeting ANSI B16.3.
f) Joints: Threaded.

c. Pipe size: 3 through 24 IN:
1) Exposed service:
a) Material: Ductile iron, Class 350 flanged.
b) Reference:
c) Lining: Cement per AWWA C104.
d) Coating: Paint.
e) Fittings: ANSI C110 ductile iron fittings, rated for 350 psi.
f) Joints: Flanged (ANSI B16.1 Class 250) or grooved type mechanical coupling (AWWA C606) joints, rated for 300 psi working pressure, with water at 100°F.
2) Buried Service:
a) Materials: Ductile iron, Class 350.
b) Reference: ANSI C151.
c) Lining: Cement, per AWWA C104.
d) Coating: Bituminous.
e) Fittings: ANSI C110 ductile iron fittings or ANSI C110, 350 psi rated gray iron fittings. Optional ANSI C153 ductile iron compact fittings for sizes 3 to 24 IN.
f) Joints: Restrained joints at all pipe joints, fittings, and valves, rated for 350 psi working pressure, Megalug 1100 TDM or equal.

AA. PIPING SPECIFICATION SCHEDULE - SYSTEM 27 - NOT USED.

BB. PIPING SPECIFICATION SCHEDULE - SYSTEM 28 - NOT USED

END OF SECTION

SECTION 15062

PIPE: DUCTILE

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - 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 300.
      c. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   2. American Society for Testing and Materials (ASTM):
      a. A183, Carbon Steel Track Bolts.
      b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      c. D1330, Rubber Sheet Gaskets.
   3. American Water Works Association (AWWA):
      a. ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
      b. ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other Liquids.
      c. ANSI/AWWA C111/A21.11, Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.
      d. ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.
      e. ANSI/AWWA C150/A21.50, Thickness Design of Ductile Iron Pipe.
      f. ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast-In-Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
      g. ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 IN through 16 IN {24 IN and 54 IN through 64 IN} for Water and Other Liquids.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.
   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. Submit manufacturer's pressure rating for all components intended for use in the finished water pump station or downstream of the finished water pumps.

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 912 (cast)).
b. Dresser (Style 127 (cast)).
c. Or approved equal.

2. Compression sleeve coupling:
   a. Rockwell (Style 431 (cast).
   b. Dresser (Style 153 (cast).
   c. Or approved equal.
3. Insulating couplings:
   a. Rockwell (Style 416).
   b. Dresser (Style 39).
   c. Or approved equal.
4. Reducing couplings:
   a. Rockwell (Style 415).
   b. Dresser (Style 62).
   c. Or approved equal.
5. Transition coupling:
   a. Rockwell (Style 413).
   b. Dresser (Style 62).
   c. Or approved equal.
6. Push-On and Mechanical Joint Pipe:
   a. U.S. Pipe.
   b. Griffin.
   c. American.
   d. Clow.
   e. Or approved equal.
7. Flanged Pipe:
   a. U.S. Pipe.
   b. Griffin.
   c. American.
   d. Clow.
   e. Or approved equal.
8. Flexible Connector:
   a. Proco Products, Inc.
   b. Red Valve Company.
   c. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MATERIALS

A. Ductile Iron Pipe:
   1. ANSI/AWWA C115/A21.15.
   2. ANSI/AWWA C150/A21.50.
   3. ANSI/AWWA C151/A21.51.

B. Fittings and Flanges:
   1. ANSI/AWWA C110/A21.10.
   2. ANSI/AWWA C115/A21.15.
   3. ANSI/AWWA C153/A21. 53.
   4. Flanges drilled and faced per ANSI B16.1 for both 125 and 250 psi applications.

C. Nuts and Bolts:
   1. Hot-dipped zinc galvanized, ASTM A307, Grade B.
   2. Heads, dimensions and threading per ANSI B1.1.
   3. Submerges bolting applications and applications within digesters: 316 stainless steel.

D. Gaskets: See individual piping system requirements in Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

E. See Piping Specification Schedules in Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

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 2.01.
      c. Supply flanges meeting standards of adjoining flanges.
      d. Rate entire assembly for test pressure specified on piping schedule for each respective application.
      e. Furnish with retainer glands and set screws.
   2. Compression sleeve coupling:
      a. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets and ASTM A307 nuts and bolts.
      b. Provide units equal to those specified in Article 2.01.
      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.

2.4 FABRICATION

A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled to be painted.

B. Furnish cast parts with lacquer finish compatible with finish coat.

2.5 LININGS AND COATINGS

A. Where specified in piping schedule, provide epoxy linings and coatings in accordance with ANSI/AWWA C151/A21.51 to a minimum thickness of 20 mils in not less than two coats. Where specified in piping schedule, provide cement mortar lining in accordance with ANSI/AWWA C104/A21.4.

2.6 SOURCE QUALITY CONTROL

A. Factory Test:
   1. Subject pipe to hydrostatic test of not less than two times the working pressure 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 ANSI/AWWA C111/A21.11.
   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 ANSI/AWWA C115/A21.15.
   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 DEG with centerline of pipe and approximately 1/4 IN back.

C. Joining Method - Flanged Joints:
1. Install in accordance with ANSI/AWWA C115/A21.15.
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. 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.
3. Provide at all interior wall penetrations and at all equipment locations.

E. 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.

F. Support exposed pipe in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

G. Install buried piping in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

H. Install restrained joint systems where specified in Section 15060 - *Pipe and Pipe Fittings: Basic Requirements* under specific piping system.

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

END OF SECTION

SECTION 15063

PIPE: COPPER

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SECTION 15063

PIPE: COPPER

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02221 - *Trenching, Backfilling, and Compacting for Utilities.*
   4. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   5. Section 15090 - *Pipe Support Systems.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B16.18, Cast Bronze Solder - Joint Pressure Fittings.
      b. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      c. B16.23, Cast Bronze Solder Joint Drainage Fittings - DWV.
      d. B16.24, Bronze Flanges and Flanged Fittings, 150 and 300 LBS.
      e. B16.26, Cast Bronze Alloy Fittings for Flared Copper Tubes.
   2. American Society for Testing and Materials (ASTM):
      a. B32, Solder Metal.
      b. B42, Seamless Copper Pipe, Standard Sizes.
      c. B88, Seamless Copper Water Tube (ANSI H23.1).
      d. B306, Copper Drainage Tube (DWV) (ANSI H23.6).
   3. American Welding Society (AWS):
      a. A5.8, Brazing Filler Material.

1.3 SUBMITTALS

A. See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

PART 2 – PRODUCTS

2.1 MATERIALS

A. Copper Tubing:
   1. Pressure non-buried: ASTM B88, Type L hard.
   2. Pressure buried: ASTM B88, Type K.
   3. Non-pressure: ASTM B306.

B. Copper Pipe: ASTM B42, regular strength.

C. Fittings:
   1. Pressure non-buried: ANSI B16.22.
   2. Pressure buried: ANSI B16.22 or B16.26.
   3. Non-pressure: ANSI B16.23

D. Soldering and Brazing:
   1. Non-buried:
      a. ASTM B32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux up to 180°F water temperature.

b. At 180°F and above, use brazing alloy with melting temperature above 1000°F and suitable flux.

2. Buried: Silver solder per AWS 5.8.

E. See Piping Schedules in Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

F. Unions:

1. Pipe sizes 2 IN and smaller:
   a. Copper, ground joint.
2. Pipe sizes 2½ IN and larger:
   a. Brass flanged unions.

PART 3 — EXECUTION

3.1 INSTALLATION

A. Comply with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

B. Utilize only annealed (soft) type tubing where flared joints are used and drawn temper (hard) type tubing where soldered or brazed joints are used.

C. Support exposed piping in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements* and Section 15090 - *Pipe Support Systems.*

D. Install buried piping in accordance with Section 02221 - *Trenching, Backfilling, and Compacting for Utilities* and Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

END OF SECTION

SECTION 15064

PIPE: PLASTIC

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SECTION 15064

PIPE: PLASTIC

1.1 SUMMARY

A. Section Includes:
   1. Plastic pipe.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

B. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. PVC (polyvinyl chloride) materials:
         1) D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
         2) D2241, (PVC) Plastic Pipe (SDR-PR and Class T).
         3) D2740, (PVC) Plastic Tubing.
         4) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
      b. Polyethylene (PE) materials:
         1) D2737, Standard Specification for Polyethylene (PE) Plastic Tubing.
         2) D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
         3) D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Material.
         4) F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
   2. American Water Works Association (AWWA):
      a. PVC (polyvinyl chloride) materials:
         1) C900, Polyvinyl chloride (PVC) pressure pipe 4 IN through 12 IN for Water.
         2) C907, Polyvinyl Chloride (PVC) Pressure Fitting for Water -4 IN through 8 IN.
      b. Polyethylene (PE) materials:
         1) C901, Polyethylene (PE) Pressure Pipe Tubing and Fittings, 1/2 IN through 3 IN for Water.
         2) C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In. (1,600 mm), for Water Distribution and Transmission.

1.3 SUBMITTALS

A. See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 PVC PRESSURE PIPING (EXPOSED) (<4 IN UNDERGROUND)

A. General: Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings. Furnish materials in full compliance to following material specifications:
   1. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
   2. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the National Sanitation Foundation (NSF).

B. Pipe: Furnish pipe meeting requirements of ASTM D1785. Pipe 4 IN and less to be solvent welded. Pipe larger than 4 IN may be either flanged or solvent welded unless shown otherwise on Drawings. Underground pipe to be solvent welded.

C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges/Unions: Furnish flanges and unions at locations shown on Drawings. Provide either flanges or unions at valves, penetrations through structures and equipment connections. For pipe larger than 4 IN, provide 150 LB socket type PVC flange. For pipe 4 IN and less, provide socket type PVC union with buna O-rings.
   1. Use flat, full faced natural rubber gaskets at flanged connections. Furnish heavy hex head bolts, each with one heavy hex nut, ASTM F593 Type 316 stainless steel.
   2. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.

E. All materials shall comply with NSF-61, and shall be marked as NSF-PW.

F. Installation:
   1. Field threading PVC will not be permitted.
   2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation. Continuously support PVC piping at liquid operating temperatures in excess of 100 Deg. F. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load. Support riser clamps on spring hangers. Do not clamp PVC tightly or restrict movement for expansion and contraction.
   3. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.
   4. Uniformity: Ensure that all piping and fittings are integrated into components of the finished system. Utilize products of a single manufacturer.
   5. Bury metallic detection tape as required in Section 10400.

2.2 PRESSURE PIPING (UNDERGROUND) (4 IN - 12 IN)

A. Materials: Furnish materials in full compliance with following requirements:
   1. 4 - 12 IN: AWWA C900 PVC DR 25, Pressure Class 150.
   2. 14 - 48 IN: AWWA C905, DR 26, Pressure Rating 160 psi.
   3. Joints for PVC pipe shall be the elastomeric-gasket push-on type with a pressure rating not less than pipe pressure rating meeting performance requirements of ASTM D3139 and in accordance with AWWA C907. Gaskets shall be part of a complete pipe section and purchased as such. Lubricant shall be as recommended by the pipe or fitting manufacturer and shall be NSF 60 approved.
   4. Joints for HDPE pipe shall be fully butt fusion welded.

B. Installation: Field threading of PVC pipe will not be permitted. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full

compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

C. Uniformity: Ensure that all piping and fittings are integrated into components of the finished system. Utilize products of a single manufacturer.

D. Certification: Pipe shall be certified to NSF International Standard No. 61.

2.3 PVC DRAINAGE, GRAVITY SEWER PIPING AND UNDERGROUND AIR DUCTS

A. Materials: Furnish materials in full compliance with following requirements:
   1. PVC and PVCO:
      a. Rigid, unplasticized PVC.
      b. Cell Classification: ASTM D1784 12454-B or 12454-C.
      c. Minimum Wall Thickness:
         1) 4 - 15 IN: ASTM D3034, SDR-35.
         2) Larger than 15 IN.: ASTM F679, PS-46
      d. Joints for PVC pipe shall be the elastomeric-gasket type meeting performance requirements of ASTM D3212 with a pressure rating not less than pipe pressure rating.

B. Installation:
   1. General:
      a. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's written instructions or recommendations and in full observance to plan details when more stringent.
      b. Installation shall be in accordance with ASTM D2321.
   2. PVC and PVCO:
      a. Push-on joints utilizing elastomeric seals in accordance with ASTM D3212 are the only allowable type permitted for PVC gravity pipe installation.
   3. Bury metallic detection tape as required in Section 10400.

C. Deflection: After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe. For 24-inch diameter and larger pipes in lieu of a mandrel test, pipe may be checked by direct measurement methods. If this option is chosen, each pipe joint must be checked at spigot, middle, and bell points. Pipe with deflection exceeding 5 percent of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 percent. Any repaired pipe shall be retested.

PART 3 – EXECUTION

3.1 IDENTIFICATION

A. Identify each length of pipe clearly at intervals of 5 FT or less. Include manufacturer's name and trademark. Nominal size of piping and critical identifications regarding ANSI/AWWA or ASTM standard requirements.

END OF SECTION

SECTION 15066

PIPE: STAINLESS STEEL

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SECTION 15066

PIPE: STAINLESS STEEL

PART 1 – GENERAL

1.1 SUMMARY

A. General work included in this Section:
   1. Stainless steel tubing, piping, fittings and appurtenances.

B. Although such work is not specifically shown or specified, all supplementary items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.

C. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - 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. B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 300.
      b. B16.5, Pipe Flanges and Flanged Fittings.
      c. B31.1, Power Piping.
   2. American Society for Testing and Materials (ASTM):
      a. A182, Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service.
      b. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      c. A312, Seamless and Welded Austenitic Stainless Steel Pipe.
      d. A320, Standard Specification for Alloy Steel Bolting Materials for Low Temperature Service.
      e. A351, Steel Castings, Austenitic, for High Temperature Service.
      f. A530, Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
      g. A774, As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
      h. A778, Welded Unannealed Austenitic Stainless Steel Tubular Products.
   3. American Water Works Association (AWWA).
      a. M11, Steel Pipe - A Guide for Design and Installation.

1.3 SUBMITTALS

A. See Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

B. Shop Drawings:
   1. Installation instructions for expansion bellows.
   2. Fabrication details and welding procedure specifications for all work to be done under this section.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Compression Fittings:
   1. Products as manufactured by Imperial, Swagelok, which meet these Specifications or approved equal.

B. Expansion Joints (Process Air Piping):
   1. Products as manufactured by Anaconda or Pathway, which meet these Specifications, or approved equal.

C. For substitutions, see Section 01640 - *Product Substitution*.

2.2 MATERIALS

A. Tubing: ASTM A269.
   1. Filler material: Extra low carbon (ELC) with 0.03 percent maximum carbon.

B. Pipe (For Pressure 0 to 25 PSIG):
   1. ASTM A312, 304L, SCH 5S

C. Pipe (For pressure to 150 PSI and temperatures to 200°F).
   1. ASTM A312, 304L, SCH 10S.

D. Pipe Fittings:
   1. ASTM A774.
   2. ASTM A351.

E. Flanges:
   1. Flat faced.
   2. Welding neck or slip on type.
   3. ASTM A182, Type 304L.

F. Nuts, Bolts and Washers:
   1. ASTM A320, Type 304.
   2. Two nuts provided for 1 IN DIA bolt applications and larger.

G. Expansion Joints:
   1. Bellows: Series 300 Stainless Steel.
   2. Liner: Series 300 Stainless Steel.
   3. Flanges: Steel.
   4. Control Tie-Rods: Steel.

H. Compression Sleeve Couplings:
   1. Per Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*, except 304 stainless steel construction.

I. Insulating Flange Sets:
   1. 1/16 IN thick plastic.
   2. Full length bolt sleeves.
   3. 1/8 IN thick insulating washers and flat washers for each flange bolt.

J. Gasket Material:
   1. Rubber or neoprene.
   2. Temperature rating of 250°F.

2.3 FABRICATION

A. All tube, piping, fitting product to be immersion pickled subsequent to manufacturing and fabrication operations and prior to shipping.
   1. Pickling solution of 6 to 10 percent nitric acid and 3 to 4 percent hydrofluoric acid.
   2. Temperature and exact concentrations to be such only a modest etch is produced but all oxidation and ferrous contamination is removed from metal surface.
   3. All pickling solution residues are to be neutralized after pickling.

B. Diameter tolerance and wall thickness tolerance are to conform to ASTM A530.

C. Joints:
   1. Shop welded circumferential butt-weld joints.
   2. Van Stone joints using angle face rings with backing flanges.
   3. ANSI B16.1, Class 150.

D. Expansion Joints:
   1. Fabricate for 15 psi internal pressure and 250°F operation.
   2. Ensure aerial travel in expansion joints of 3.1 IN minimum for 15,000 cycles or 5.2 IN for 1000 cycles.
   3. Furnish each assembly with minimum four control tie rods.
   4. Fabricate with 125 LB flanged end connections.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect and verify condition of piping and appurtenances. Installation constitutes installer's acceptance of condition for satisfactory installation.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

B. Ensure ends of pipe to be fitted with flanges have all protrusions ground flush.

3.3 INSTALLATION

A. Ensure all pipe cutting, threading and jointing conforms to requirements of ANSI B31.1. Lubricate all pipe threads with Teflon tape.

B. Welding:
   1. Provide welds sounds and free from embedded scale or slag, and tensile strength at weld not less than pipe.
   2. Perform butt welds only with an inert gas shielded process.
   3. Adequate inert gas protection is to be provided to the top and under or backside of the weld to protect from atmospheric contamination.
   4. Filler metal is to be applied to all manually performed welds appropriate for the base material being welded.
   5. Only inert gas shielded welding processes are to be used for spool fabrication.
   6. Provide butt welds with 100 percent penetration to the interior or back side of the weld joint.
   7. Weld reinforcement on both sides of the weld are to be smooth, uniform and no more that 1/16 IN height.

C. Joining Method - Flanges:
   1. Leave 1/8 to 3/8 IN flange bolts projecting beyond face of nut after tightening. Coordinate dimensions and drillings of flanges with flanges for valves, pumps,

equipment, and other systems. Tighten bolts evenly around pipe until following range of torques are achieved.

Bolt Size, IN	Ranges of Torque, FT-LB
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1- 1/4	90 - 120

D. Compression Sleeve Couplings:
   1. Install coupling to allow space of not less than 1/4 IN but no more than 1 IN.
   2. Provide harnessed joint unless otherwise shown on Drawings or specified. Use joint harness arrangements detailed in AWWA M11 or as indicated on Drawings.

E. Expansion Joints:
   1. Install in accordance with manufacturer's instructions.
   2. Install when outside temperature is between 50EF to 70EF.

3.4 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

3.5 CLEANING

A. Clean in accordance with Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

END OF SECTION

SECTION 15090

PIPE SUPPORT SYSTEMS

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SECTION 15090

PIPE SUPPORT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe support and anchor systems.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - *Painting and Protective Coatings.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B31.1, Power Piping.
      b. B31.3, Chemical Plant and Petroleum Refinery Piping.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A510, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
      c. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M Grade.
   3. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
   4. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
      a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP-69, Pipe Hangers and Supports - Selection and Application.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.
      d. Scale drawings showing guides, hangers, supports, anchors, structural members and appurtenances to describe the pipe support system.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Hanger Rods:
   1. Material: ASTM A36, A510, and A575.
   2. Continuously threaded.
   3. Electro-galvanized or cadmium plated after threads are cut.

4. Load limit:

Nominal Rod Diameter	Maximum Safe Load, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

B. Hangers:

1. Hangers for use directly on copper pipe: Copper or cadmium plated.
2. Hangers for use other than directly on copper pipe: Cadmium plated or galvanized.
3. Hanger type schedule:

Application	Pipe Size	Hanger Type
All except noted	4 IN & less	ITT Grinnell Figure 108 with Figure 114
All except noted	Over 4 IN	ITT Grinnell Figure 590
Steam, condensate and hot water	All	ITT Grinnell Figure 181, Figure 82 or equal

C. Concrete Inserts for Hanger Rods:

1. Continuous slots: Unistrut #P1000.
2. Individual inserts: ITT Grinnell Figure 281.
3. Self-drilling expansion anchors: Phillips flush-end or snap-off end type.

D. Beam Clamps for Hanger Rods:

1. Heavy duty.
2. ITT Grinnell Figure 134.

E. Trapeze Hangers for Suspended Piping:

1. Material: Steel.
2. Galvanized.
3. Angles, channels, or other structural shapes.
4. Curved roller surfaces at support point corresponding with type of hanger required.

F. Vertical Pipe Supports:

1. At base of riser:
2. Lateral movement:
   a. Clamps or brackets:
      1) ITT Grinnell Figure 261.
      2) For copper tubing, ITT Grinnell Figure CT-121.

G. Expanding Pipe Supports:

1. Spring hanger type.
2. MSS SP-58.

H. Pipe Support Saddle:

1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on Drawings.
2. ITT Grinnell Figure 264.

I. Pipe Support Risers:

1. Schedule 40 pipe.
2. Galvanized.
3. As recommended by saddle manufacturer.

J. Pipe Support Base Plate:

1. 4 IN larger than support.
2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.

4. Collar welded to floor plate.
5. Edges ground smooth.
6. Assembly hot dipped galvanized after fabrication.

K. Pipe Covering Protection Saddle:
1. For insulated pipe at point of support.
2. ITT Grinnell Figure 167, Type B.

L. Wall Brackets:
1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
2. ITT Grinnell Figure 199.

M. Pipe Anchors:
1. For locations shown on the Drawings.
2. 1/4 IN steel plate construction.
3. Hot dipped galvanized after fabrication.
4. Designed to prevent movement of pipe at point of attachment.

N. Pipe Guides:
1. For locations on both sides on each expansion joint or loop.
2. To ensure proper alignment of expanding or contracting pipe.
3. ITT Grinnell Figure 256.

O. Substitutions:
1. Submit requests for substitutions in accordance with Section 01640 - *Product Substitution*.

2.2 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ANSI B31.3.
2. MSS SP-58 and SP-69.
3. Except where modified by this Specification.

E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ANSI B31.1.
2. MSS SP-58 and SP-69.

F. Check all physical clearances between piping, support system and structure.
1. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser. Support pipes for lateral movement with clamps or brackets.

H. Place hangers on outside of pipe insulation. Use a pipe covering protection saddle for insulated pipe at support point.
1. Insulated piping 1½ IN and less:
a. Provide a 9 IN length of 9 LB density fiberglass insulation at saddle.

2. Insulated piping over 1½ IN:
   a. Provide a 12 IN length of 9 LB density fiberglass insulation on saddle.

I. Provide 20 GA galvanized steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.

J. Pipe Support Spacing:
1. General:
   a. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
   b. Provide at least one support for each length of pipe at each change of direction and at each valve.
2. Steel, stainless steel, cast-iron pipe support schedule:

Pipe Sizes - IN	Maximum Span - FT
1½ and less	5
2 through 4	10
5 through 8	15
10 and greater	20

3. Copper pipe support schedule:

Pipe Sizes - IN	Maximum Span - FT
2½ and less	5
3 through 6	10
8 and greater	15

4. PVC pipe support schedule:

Pipe Sizes - IN	Maximum Span - FT
1¼ and less	3
1½ through 3	4
4 and greater	5

* Maximum fluid temperature of 120°F.

5. Support each length and every fitting:
   a. Bell and spigot piping:
      1) At least one hanger.
      2) Applied at bell.
   b. Mechanical coupling joints:
      1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
7. Provide continuous support for nylon tubing.
8. Support all valves 8" and greater and sewage grinders with concrete pipe support unless explicitly noted otherwise. See Drawings for concrete pipe and valve support detail. All other valves and pipe runs shall utilize metal pipe support.
9. Support all base elbows with a base elbow support. See Drawings for base elbow support detail.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
1. Included in this requirement are movements from:
   a. Trap discharge.
   b. Water hammer.
   c. Similar internal forces.

B. Weld Supports:
1. AWS D1.1.
2. Weld anchors to pipe in accordance with ANSI B31.3.

C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Inspect hangers for:
   1. Design offset.
   2. Adequacy of clearance for piping and supports in the hot and cold positions.
   3. Guides to permit movement without binding.
   4. Adequacy of anchors.

E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.

F. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
   1. Install concrete inserts as concrete forms are installed.

G. Welding:
   1. Welding rods: ASTM and AWS standards.
   2. Integral attachments:
      a. Include welded-on ears, shoes, plates and angle clips.
      b. Ensure material for integral attachments is of good weldable quality.
   3. Preheating, welding and postheat treating: ANSI B31.3, Chapter V.

H. Field Painting:
   1. Comply with Section 09905 - *Painting and Protective Coatings.*

END OF SECTION

SECTION 15100

VALVES: BASIC REQUIREMENTS

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09905 - *Painting and Protective Coatings.*
   4. Section 11005 - *Equipment: Basic Requirements.*
   5. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   6. Section 15101 - *Gate Valves.*
   7. Section 15102 - *Plug Valves.*
   8. Section 15103 - *Butterfly Valves.*
   9. Section 15104 - *Ball Valves.*
   10. Section 15106 - *Check Valves.*
   11. Section 15114 - *Miscellaneous Valves.*

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.
   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. C509, Resilient-Seated Gate Valves 3 through 12 NPS, for Water and Sewage Systems.
      f. C540, Power-Actuating Devices for Valves and Sluice Gates.
      g. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
   4. National Electrical Manufacturers Association (NEMA):
      a. MG 1, Motors and Generators.
      b. ICS 6, Enclosures for Industrial Controls and Systems.
   5. National Sanitation Foundation (NSF).

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. SWP: Steam working pressure.
   3. WOG: Water, oil, gas working pressure.
   4. WWP: Water working pressure.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenonce Manuals; and Miscellaneous Submittals.*
   2. Product technical data including:
      a. Acknowledgment 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.
      i. Submit NSF 61 certification.
   3. Test reports.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

C. Manufacturer certification that valve materials are suitable for chemicals being serviced.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to individual valve specification sections.

B. Electric Actuators:
   1. Auma (Type SA for open/close or SAR for modulating)
   2. Limitorque
   3. Rotork
   4. Or approved equal.

2.2 MATERIALS

A. All materials shall comply with NSF-61.

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 and withstand without damage a pull of 200 LB.

B. Buried Valve Actuators:
   1. Provide screw or slide type adjustable cast iron box, 5 IN minimum diameter, and identifying cover.
   2. Box base to enclose buried valve gear box or bonnet.
   3. Provide 2 IN AWWA standard valve actuator nut.
   4. Provide stem extension to grade with guide bushing to center extension.
   5. Provide cast iron floor stands where shown on Drawings. Stands to be furnished by valve manufacturer with actuator.

a. Stand or actuator to include thrust bearings for valve operation and weight of accessories.

C. Manual Actuators:
1. Provide for all 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 to have a minimum of five (5) intermediate lock positions between full open and full close.
4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
7. Provide chain actuators for valves 6 FT or higher from finish floor.
a. Cadmium-plated chain looped to within 3 FT of finish floor.
b. Equip chain wheels with chain guide to permit rapid operation with reasonable side pull and without "jambing" the wheel.
c. Provide hook so that chain may be stored clear of walkways.

D. Electric Actuators:
1. General:
a. Self contained including motor, gearing, reversing contractor, limit switches, cast housing.
b. Electrical enclosure: NEMA 4X.
c. Factory assembled requiring only field connection of power and control wires.
d. Assembled with motor and control above or to side of valve and gear box.
e. Comply with Section 11005 - *Equipment: Basic Requirements.*
2. Motors:
a. Produce 1.5 time required torque.
b. Sized for four complete open-close cycles without overheating and to open valve within 60 SEC. Modulating valves shall be sized for 1200 starts per hour, with contacts rated the same, without overheating.
c. Motor with Class F insulation.
d. Operate at 10 percent voltage.
e. Valves 3 IN and smaller: 120 V, 1 PH.
f. Valves 4 IN and larger: 208 V, 3 PH.
g. Provide thermal cutout overload switches and internal heater wired to control enclosure.
3. Gearing:
a. Conform to AWWA C504.
b. Provide auxiliary handwheel for manual operation, automatically disengaged if motor energized.
4. Controls: Provide prewired control enclosure for each valve actuator:
a. Reversing contactor and control power transformer.
b. Open-close adjustable limit switches.
c. Open-closed signal limit switches.
d. Local open-close-stop push button station.
e. Local open-green, close-red indicating light.
f. Space heater for control enclosure.
g. Torque limit switch for worm gear actuators preset at50 percent of maximum.
h. Modulating valves:
1) Provide manual-automatic switch and solid state modulator to receive 4-20 MA control signal and actuate valve to signaled position.
2) Provide valve position transmitter.
i. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

2.4 FABRICATION

A. End Connections:
   1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section15060 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.

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.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements:
   1. Comply with Section 09905 - *Painting and Protective Coatings* for painting and protective coatings.

C. Setting Buried Valves:
   1. Locate valves installed in trenches where 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, fill in earth for distance of 4 FT on each side of box.

D. 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.

E. Install electric or cylinder actuator above or horizontally adjacent to valve and gear box.

F. For threaded valves, provide union on one side to allow valve removal.

G. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTING

A. Adjustment of valves, actuators and appurtenant equipment to comply with Section 01650 - *Project Systems*. Operate valve, open and close at system pressures.

3.3 SCHEDULES

A. Refer to the following for schedule of valves 4 IN and larger.

1. Valves less than 4 IN are not scheduled but type and size are defined on Drawings in plan, section, or schematic.

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Tag	Description	Location	Size	Valve Type	End Type	Operator	Pressure Rating (psi)	Notes
V-014	Cla-Val Control Valve	Control Valve Vault/Energy Recovery building	18	Pressure Sustaining	Flanged	Hydraulic	150	Location varies based on Bid Alternate Chosen
V-015	South Fork pipeline DS of Control Valve Mag	Yard	19	Butterfly	MJ	Nut	151	
V-016	MF Connection to Low Pressure	Yard	20	Butterfly	MJ	Nut	150	
V-017	Turbines Bypass Valve	Yard	24	Butterfly	MJ	Nut	150	
V-018	MF Isolation from Bypass	Yard	20	Butterfly	MJ	Nut	150	Bid Alternate A
V-019	Booster PS Suction Line Isolation	Yard	18	Butterfly	MJ	Nut	150	Bid Alternate A
V-020	Booster PS FM Line Isolation	Yard	18	Butterfly	MJ	Nut	150	Bid Alternate A
V-021	Sedimentation Basin Isolation	Yard	36	Butterfly	MJ	Handwheel	150	
V-022	CCT #1 Drain	Yard	8	Butterfly	MJ	Nut	150	
V-023	CCT #2 Drain	Yard	8	Butterfly	MJ	Nut	150	
V-101	Sump Pump Clearing Valve	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-102	Mix Valve #1	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-103	Mix Valve #2	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-104	Lagoon Discharge Valve	Raw Water PS	4	Plug	Flanged	Nut	150	Bid Alternate A
V-105	Turbine TR-6 Isolation	Energy Recovery Buildng	12	Butterfly	Flanged	Electric	150	Bid Alternate B
V-106	Turbine TR-10 Isolation	Energy Recovery Buildng	16	Butterfly	Flanged	Electric	150	Bid Alternate B
V-107	Turbine TR-6 Discharge Isolation	Energy Recovery Buildng	12	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-108	Turbine TR-10 Discharge Isolation	Energy Recovery Buildng	16	Butterfly	Flanged	Handwheel	150	Bid Alternate B
V-109	Floc Basin No. 4 Drain	Floc Basin No. 4	12	Mud	Flanged	Horizontal Handwheel (Indicating)	150	
V-110	Floc Basin No. 5 Drain	Floc Basin No. 5	12	Mud	Flanged	Horizontal Handwheel (Indicating)	150	

V-111	Floc Basin No. 6 Drain	Floc Basin No. 6	12	Mud	Flanged	Horizontal Handwheel (Indicating)	150
V-112	Floc Effluent Channel Drain	Floc Effluent Channel	12	Mud	Flanged	Horizontal Handwheel (Indicating)	150
V-113	P-105 Suction Isolation	Booster PS	20	Butterfly	Flanged	Handwheel	150
V-114	P-105 Check	Booster PS	16	Check	Flanged	Air Cushioned	150
V-115	P-105 Isolation	Booster PS	16	Butterfly	Flanged	Handwheel	150
V-116	P-106 Suction Isolation	Booster PS	20	Butterfly	Flanged	Handwheel	150
V-117	P-106 Check	Booster PS	16	Check	Flanged	Air Cushioned	150
V-118	P-106 Isolation	Booster PS	16	Butterfly	Flanged	Handwheel	150
V-119	P-106 Suction Isolation	Booster PS	20	Butterfly	Flanged	Handwheel	150
V-120	P-107 Check	Booster PS	16	Check	Flanged	Air Cushioned	150
V-121	P-107 Isolation	Booster PS	16	Butterfly	Flanged	Handwheel	150
V-203	Blower #1 Check	Blower Room	10	Double Door Check	Flanged	Spring	20
V-204	Blower #2 Inlet	Blower Room	10	Butterfly	Flanged	Handwheel	20
V-205	Blower #2 Isolation	Blower Room	10	Butterfly	Flanged	Handwheel	20
V-206	Blower #2 Check	Blower Room	10	Double Door Check	Flanged	Spring	20
V-207	CCT #1 Entrance	CCT Pipe Gallery	42	Butterfly	Flanged	Nut	50
V-208	CCT Separation Valve	CCT Pipe Gallery	42	Butterfly	Flanged	Nut	50
V-209	CCT #2 Exit Valve	CCT Pipe Gallery	42	Butterfly	Flanged	Nut	50
V-211	AC-1 Inlet Valve	AC Pipe Gallery	16	Butterfly	Flanged	Electric (Modulating)	50
V-212	AC-1 Isolation Valve	AC Pipe Gallery	16	Butterfly	Flanged	Handwheel	50
V-213	AC-1 Flush Valve	AC 1&2 Flush Gallery	16	Butterfly	Flanged	Electric (Open/Close)	50
V-214	AC-1 Drain Valve	AC 1&2 Flush Gallery	4	Butterfly	Flanged	Handwheel	50
V-215	AC-2 Inlet Valve	AC Pipe Gallery	16	Butterfly	Flanged	Electric (Modulating)	50
V-216	AC-2 Isolation Valve	AC Pipe Gallery	16	Butterfly	Flanged	Handwheel	50
V-217	AC-2 Flusch Valve	AC 1&2 Flush Gallery	16	Butterfly	Flanged	Electric (Open/Close)	50
V-218	AC-2 Drain Valve	AC 1&2 Flush Gallery	4	Butterfly	Flanged	Handwheel	50

V-219	AC-3 Inlet Valve	AC Pipe Gallery	16	Butterfly	Flanged	Electric (Modulating)	50
V-220	AC-3 Isolation Valve	AC Pipe Gallery	16	Butterfly	Flanged	Handwheel	50
V-221	AC-3 Flush Valve	AC-3 Flush Gallery	16	Butterfly	Flanged	Electric (Open/Close)	50
V-222	AC-3 Drain Valve	AC-3 Flush Gallery	4	Butterfly	Flanged	Handwheel	50
V-223	AC Pressure Relief Valve	AC Pipe Gallery	8	Pressure Relief	Flanged	Hydraulic	50
V-224	Relief Valve Isolation	AC Pipe Gallery	8	Butterfly	Flanged	Handwheel	50
V-231	AC-1 Air Inlet Valve	AC Pipe Gallery	10	Butterfly	Flanged	Electric (Open/Close)	20
V-232	AC-1 Air Check Valve	AC Pipe Gallery	10	Doubledoor Check	Flanged	N/A	20
V-233	AC-2 Air Inlet Valve	AC Pipe Gallery	10	Butterfly	Flanged	Electric (Open/Close)	20
V-234	AC-2 Air Check Valve	AC Pipe Gallery	10	Doubledoor Check	Flanged	N/A	20
V-235	AC-3 Air Inlet Valve	AC Pipe Gallery	10	Butterfly	Flanged	Electric (Open/Close)	20
V-236	AC-3 Air Check Valve	AC Pipe Gallery	10	Doubledoor Check	Flanged	N/A	20
V-241	Filter #1 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50
V-242	Filter #1 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50
V-247	Filter #2 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50
V-248	Filter #2 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50
V-253	Filter #3 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50
V-254	Filter #3 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50

V-259	Filter #4 Influent A	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-260	Filter #4 Influent B	Filter Influent Channel #1	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-265	Filter #5 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-266	Filter #5 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-267	Filter #5 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-268	Filter #5 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-269	Filter #5 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-270	Filter #5 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-271	Filter #6 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-272	Filter #6 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-273	Filter #6 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-274	Filter #6 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-275	Filter #6 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-276	Filter #6 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-277	Filter #7 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-278	Filter #7 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	

V-279	Filter #7 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-280	Filter #7 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-281	Filter #7 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-282	Filter #7 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-283	Filter #8 Influent A	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-284	Filter #8 Influent B	Filter Influent Channel #2	16	Butterfly	Flanged	Electric (Open/Close) 5' Extended Neck	50	
V-285	Filter #8 Effluent	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Modulating)	50	
V-286	Filter #8 to Waste	Filter 1-5 Pipe Gallery	8	Butterfly	Flanged	Electric (Open/Close)	50	Adjust to stop at normal filter flowrate
V-287	Filter #8 Backwash Supply	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-288	Filter #8 Backwash Drain	Filter 1-5 Pipe Gallery	18	Butterfly	Flanged	Electric (Open/Close)	50	
V-289	Fitler Air Scour Isolation	Air Scour Gallery	10	Butterfly	Flanged	Handwheel	20	
V-291	Filter #1 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20	
V-292	Filter #2 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20	
V-293	Filter #3 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20	
V-294	Filter #4 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20	
V-295	Filter #5 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20	
V-296	Filter #6 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20	

V-297	Filter #7 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20
V-298	Filter #8 Air Inlet	Air Scour Gallery	8	Butterfly	Flanged	Electric (Open/Close	20
V-299	AC Air Scour Isolation	Air Scour Gallery	10	Butterfly	Flanged	Handwheel	20

END OF SECTION

SECTION 15101

GATE VALVES

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 15100 - *Valves: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Works Association (AWWA):
      a. C500, Gate Valves for Water and Sewerage Systems.
      b. C509, Resilient Seated Gate Valves, 3 through 12 NPS, for Water and Sewerage Systems.
   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.
   3. National Sanitation Foundation (NSF)

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 - *Valves: Basic Requirements.*

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

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 Section 01640 - *Product Substitution.*

C. All components in contact with fluid shall comply with NSF-61.

2.2 VALVE: WATER; AIR; 2½ IN AND SMALLER

A. Class 125 bronze gate valve.

B. Comply with MSS SP-80.

C. Acceptable Manufacturers:
1. Nibco.
2. Stockham.
3. Or approved equal.

D. Materials:
1. Body, bonnet, wedge: Bronze.
2. Stem: Silicon bronze.
3. Packing: Teflon or TFE impregnated fibre.

E. Design Requirements:
1. 200 psi nonshock WOG.
2. Screw in bonnet, non-rising stem, solid wedge.

2.3 VALVES: NON-POTABLE WATER; POTABLE WATER; 3 TO 12 IN DIA

A. Resilient Seat Gate Valves, 3 to 12 IN DIA.
1. Comply with AWWA C515
2. Materials:
a. Stem & stem nut - bronze.
b. Body, gate - cast iron.
c. Resilient seat - Styrene Butadiene Rubber (SBR).
3. Design requirements:
a. 200 psi working pressure.
b. Buried - NRS O-ring stem seal.
c. Exposed - OS&Y, stuffing box stem seal.

B. Acceptable Manufacturers:
1. Clow.
2. Dezurik.

2.4 VALVE: STEAM, 125 PSI TO 200 PSI - NOT USED

2.5 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators. Furnish actuator integral with valve.

B. Refer to Section 15100 - *Valves: Basic Requirements* for actuator requirements.

2.6 FABRICATION

A. General:
1. Provide valves with clear waterways the full diameter of the valve.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 15100 - *Valves: Basic Requirements*.

B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.

C. 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 15103

BUTTERFLY VALVES

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SECTION 15103

BUTTERFLY VALVES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Butterfly valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 15060 - *Pipe and Pipe Fittings: Basic Requirements.*
   4. Section 15100 - *Valves: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B16.1, Pipe Flanges and Flanged Fittings.
   2. American Society for Testing and Materials (ASTM):
      a. A48, Specifications for Gray Iron Castings.
      b. A126, Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      c. A536, Ductile Iron Castings.
   3. American Water Works Association (AWWA):
      a. C504, Rubber Seated Butterfly Valves.
   4. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
      a. SP-67, Butterfly Valves.
   5. National Sanitation Foundation International (NSF)/ANSI:
      a. Standard 61.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100 - *Valves: Basic Requirements.*
   2. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504 and NSF/ANSI 61.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Water:
      a. DeZurik.
      b. Clow.
      c. Dresser.
      d. Tyco Flow Control.
      e. Henry Pratt Company.
      f. Or approved equal.
   2. Air:
      a. Pratt.

b. Hoffman.
c. Lawson.
d. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution*.

2.2 BUTTERFLY VALVES - FOR WATER SERVICE

A. Comply with AWWA C504 and NSF-61.

B. Materials:
1. Valve bodies:
   a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
   b. Flanged end only drilled with ANSI B16.1, Class 250.
2. Valve shafts:
   a. Stainless steel, 18-8, Type 304 or 316.
3. Valve discs:
   a. Potable and nonpotable water:
      1) ASTM A48, Class 40 cast iron.
   b. Finished Water:
      1) ASTM A536 Grade 65-45-12.
      2) Edge: 316 stainless steel.
4. Valve seats:
   a. Potable and nonpotable water below 150°F:
      1) EPDM.
   b. Potable and nonpotable water and wastewater and air below 180°F:
      1) Buna-N.
   c. Heating water and air 180 to 250°F.
      1) EPDM.
5. Mating surfaces:
   a. Valves less than 30 IN: ASTM A276, 18-8, stainless steel or bronze.

C. Design Requirements:
1. Seat type: Resilient. Comply with AWWA C504.
2. Exposed and submerged valves 3 through 24 IN.
   a. Body type: Wafer or short body flange (laying length may vary from AWWA C504).
   b. Working pressure: Per valve schedule in Section 15100 - *Valves: Basic Requirements*.
   c. Equip wafer type with fully tapped anchor lugs drilled per ANSI B16.5.
3. Exposed and submerged valves 24 IN and larger:
   a. Body type: Short body flange.
   b. Working pressure: Per valve schedule in 15100 - *Valves: Basic Requirements*.
4. Direct buried valves:
   a. Working pressure: Per valve schedule in Section 15100 - *Valves: Basic Requirements*.
   b. Extruded stem, 1' long required for all buried butterfly valves.
5. Manual actuator maximum pull to be 80 lbs; should withstand without damage a pull of 200 lbs.

2.3 BUTTERFLY VALVES (MSS SP-67) - FOR AIR SERVICE

A. Comply with MSS SP-67.

B. Materials:
1. Valve bodies:
   a. Wafer body: Cast iron ASTM A126, Class B.
2. Valve shaft or stem:
   a. Stainless steel, ASTM A276, Type 316.
3. Valve disc:

a. Ductile iron, ASTM A395, nickel plated, or Aluminum bronze, ASTM B148, Alloy 954.

4. Valve seat:
   a. Water and air below 180°F:
      1) Buna-N.
   b. Water and air 180 to 250°F:
      1) EPDM.
   c. Valve seat shall be a full body seat isolating stem and body from flow.

C. Design Requirements:

1. Exposed and submerged valves 3 IN through 20 IN.
   a. Body type: Wafer.
   b. Working pressure: Rated for 150 psi.
   c. Equip with fully tapped anchor lugs drilled per ANSI B16.5.

2.4 ACCESSORIES

A. Refer to Drawings and/or valve schedule for type of actuators. Furnish actuator integral with valve.

B. Refer to Section 15100 - *Valves: Basic Requirements* for actuator requirements.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 15100 - *Valves: Basic Requirements.*

END OF SECTION

SECTION 15104

BALL VALVES

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 15100 - *Valves: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A48, Gray Iron Castings (Class 35 Minimum).
      b. A126, Gray Iron Castings for Valves Flanges, and Pipe Fittings.
      c. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   2. American Water Works Association (AWWA):
      a. C507, Ball Valves 6 IN through 48 IN Diameter.
   3. Federal Specification:
      a. WW-V-35B.
   4. National Sanitation Foundation (NSF)/ANSI:
      a. Standard 61.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100 - *Valves: Basic Requirements.*
   2. Test results for AWWA valves.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

C. Certificate of NSF/ANSI Standard 61 approval.

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 Section 01640 - *Product Substitution.*

2.2 METALLIC BALL VALVES 1/4 IN TO 3 IN DIA (FOR SERVICES WITH METAL PIPES)

A. Comply with Federal Specification WW-V-35B Type II, Class A and NSF-61.

B. Acceptable Manufacturers:
   1. Apollo.
   2. Jamesbury.

3. Watts.
4. Stockham.
5. Or approved equal.

C. Materials:
1. Body: Brass.
2. Stem, stem gland nut: Brass.
3. Ball: Brass, chrome plated.
4. Seats, stuffing box ring, and thrust washer: PTFE.
5. Handle: Vinyl coated or zinc- or cadmium-plated steel.

D. Design Requirements:
1. Rated for 600 psi WOG and 150 psi saturated steam service for threaded end applications.
2. Handles showing direction of opening.
3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
4. Stem with reinforced PTFE stuffing box ring and blowout-proof design.
5. Renewable reinforced PTFE seats.
6. Ball design which does not allow media contact with stem.
7. Balancing stop for all applications.
8. Bodies with mounting pad for applications requiring actuators.

2.3 PVC BALL VALVES 1/2 IN TO 6 IN DIA (FOR ANY SERVICE UTILIZING PVC PIPE)

A. Acceptable Manufacturers:
1. Chemtrol.
2. Spears.
3. ASAHI/America.
4. Or approved equal.

B. Materials:
1. Body, stem, ball, handle, end connectors:
a. PVC ASTM D1784-12454B
2. Seat: PTFE.
3. O-rings: Viton®.

C. Design Requirements:
1. Rated at 150 psi at 75°F.
2. True union design.
3. Blocks both directions, upstream and downstream.
4. External adjustment for seat wear.
5. Body with mounting pad for actuators where required.
6. Locking handle or spring return handle.
7. Comply with NSF-61.

2.4 PVDF BALL VALVES (FOR ANY SERVICE UTILIZING PVDF PIPES)

A. Acceptable Manufacturers:
1. Simtech Industrial Products.
2. Georg Fischer.
3. Chemtrol.
4. Or approved equal.

B. Materials:
1. Body, stem, ball, handle, end connectors: PVDF ASTM D-3222.
2. Seat: PTFE.
3. O-ring: Viton®.

C. Design Requirements:

1. Rated at 175 psi @ 75°F.
2. True Union design.
3. Block both directions upstream and downstream.
4. Body with mounting pad for actuators where required.
5. Locking handle or spring return handle.
6. Comply with NSF-61.

2.5 CPVC BALL VALVES

A. Acceptable Manufacturers:
1. Chemtrol.
2. ASAHI/America.
3. Spears.
4. Or equal.

B. Material:
1. Body, stem, ball, handle, end connectors: CPVC ASTM F441.
2. Seat: Teflon.
3. O-ring: EPDM.

C. Design Requirements:
1. Rated at 175 psi @ 75°F.
2. True Union design.
3. Blocks both directions, upstream and downstream.
4. Body with mounting pad for actuators where required.
5. Locking handle or spring return handle.
6. Sodium hydroxide service valves shall be vented with small weep hole on one side of valve ball.
7. Comply with NSF-61.

2.6 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators. Furnish actuator integral with valve.

B. Refer to Section 15100 - *Valves: Basic Requirements* for actuator requirements.

PART 3 – PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 15100 - *Valves: Basic Requirements.*

END OF SECTION

SECTION 15106

CHECK VALVES

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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 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - 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.
   4. National Sanitation Foundation (NSF).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100 - *Valves: Basic Requirements.*

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

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 Section 01640 - *Product Substitution.*

2.2 CHECK VALVES: 3 IN AND SMALLER

A. CPVC, PVC, or PVDF Swing Check:
   1. Comply with MSS SP-80 and NSF-61
   2. Acceptable manufacturers:
      a. ASAHI/America.
      b. Or approved equal.
   3. Materials:
      a. Body: Match service pipe.
      b. Seat B O-rings:
         1) SA: Teflon.

2) All others: EPDM.

4. Design requirements:
   a. 125 psi steam to 406°F, 200 psi WOG.
   b. Horizontal swing, renewable disc.
   c. True Union connectors.
   d. Comply with NSF-61.

2.3 SWING CHECK: VALVES (3 IN TO 24 IN) (WATER SERVICE)

A. Swing Check Valve:
   1. Comply with AWWA C508.
   2. Acceptable manufacturers:
      a. Kennedy.
      b. Mueller.
      c. Or approved equal.
   3. Materials:
      a. Body and cover: Cast iron.
      b. Seat ring, hinge: Bronze.
      c. Disc:
         1) 3 IN to 4 IN: Bronze.
         2) 6 IN to 24 IN: Cast iron with bronze face.
         3) 6 IN to 24 IN: Cast iron with rubber face.
      d. Hinge shaft: Stainless steel.
      e. Bearings, connecting hardware: Bronze.
   4. Design requirements:
      a. 175 psi working pressure (3 IN to 12 IN).
      b. 150 psi working pressure (14 IN to 24 IN).
      c. Furnish with outside weight and lever or lever and spring.
      d. Unless otherwise shown on the Drawings, use for water, wastewater, and sludge.
      e. Comply with NSF-61.

B. Class 125 Iron Check Valves (Air Service):
   1. Comply with MSS SP-71 and NSF-61.
   2. Acceptable manufacturers:
      a. Nibco F918B.
      b. Stockham G931.
      c. Or approved equal.
   3. Materials:
      a. Iron body, bronze mounted.
      b. Seat ring, disc face: Bronze.
      c. Hinge pin: Bronze or stainless steel.
      d. Connecting hardware: Bronze or plated steel.
   4. Design requirements:
      a. 125 psi steam to 450°F, 200 psi WOG.
      b. Bolted cap.
      c. Furnish with outside weight and lever or lever and spring.

C. Class 250 Iron Check Valve (Steam 125 to 250 psi):
   1. Comply with MSS SP-71, Type 1.
   2. Acceptable manufacturers:
      a. Nibco F968B.
      b. Stockham F947.
      c. Or approved equal.
   3. Materials:
      a. Iron body, bronze mounted.
      b. Seat ring, disc face: Bronze.
      c. Hinge pin: Brass.
      d. Connecting hardware: Bronze.
   4. Design requirements:

a. 250 psi steam to 450□F, 500 psi WOG.
b. Bolted cap.

2.4 CUSHIONED SWING CHECK VALVE (WATER SERVICE): (2 IN TO 24 IN)

A. Class 125.

B. Comply with AWWA C508 and NSF-61.

C. Acceptable Manufacturers:
1. Air:
a. Golden Anderson Figure 250 (Class 125).
b. APCO Series 6000.
c. Or approved equal.
2. Oil:
a. APCO Series 6100.
b. Golden Anderson Figure 25-DXH.
c. 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 cylinder: Metallic corrosion resistant material.

E. Design Requirements:
1. Seat ring: Replaceable.
2. Hinge: Extend out both sides with lever and weight.
3. Cushion: Oil type with adjustable speed control.

2.5 DOUBLE DOOR CHECK VALVES (LOW PRESSURE AIR SERVICE)

A. Class 125.

B. Acceptable Manufacturers:
1. APCO Series 9000 (2 IN to 48 IN).
2. Nibco W920W (2 IN to 24 IN).
3. Or approved equal.

C. Materials:
1. Body: Cast iron threaded lug style.
2. Doors:
a. 2 IN to 12 IN: Aluminum bronze.
b. 14 IN to 54 IN: Ductile iron, bronze faced.
3. Hinge and stop pins: Stainless steel, 316.
4. Spring: Stainless Steel, T316.
5. Seat: Buna-N.

2.6 SILENT CHECK VALVES

A. Class 125, ANSI B16.1.

B. Acceptable Manufacturers:
1. APCO Series 300 or 600.
2. Clow 375, 636.
3. Or approved equal.

C. Materials:

1. Body: Cast iron.
2. Plug and seat: Bronze.
3. Spring: Stainless steel.

D. Design Requirements:
1. Body type:
a. 1 IN to 10 IN: Wafer.
b. 3 IN to 30 IN: Flanged center guided, globe style.

2.7 BALL CHECK VALVES (1/2 IN TO 3/4 IN.)

A. 150 psi at 73°F.

B. Acceptable Manufacturers:
1. R&G Sloane.
2. Corr Tech.
3. Or approved equal.

C. Materials:
1. Body: To match service pipe.

D. Design Requirements:
1. Connectors: Double union.
2. Comply with NSF-61.

PART 3 – EXECUTION

3.1 INSTALLATION

A. See Section 15100 - Valves: Basic Requirements.

B. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15114

MISCELLANEOUS VALVES

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SECTION 15114

MISCELLANEOUS VALVES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Air release valves.
2. Back flow preventers.
3. Solenoid valves.
4. Back pressure/Anti-siphon valve.
5. Pump control valves.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - 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.
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.
   c. C511, Reduced Pressure Principle Backflow Prevention Assemblies for Containment.
4. NSF/ANSI Standard 61.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 15100 - *Valves: Basic Requirements.*

B. Operation and Maintenance Manuals:
1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

C. Certificate of NSF/ANSI Standard 61 approval.

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 Section 01640 - *Product Substitution.*

2.2 AIR RELEASE VALVES

A. General:
1. Conform to AWWA C512.

B. Air Release Valve:
1. Acceptable manufacturers:
a. Cla-Val Model 33A.
b. Or approved equal.
2. Materials:
a. Body and cover: Cast iron or semi-steel.
b. Float and linkage: Stainless steel.
c. Seat: Viton or Buna-N.
3. Design requirements:
a. Working pressure as required for connected piping. Note that all FW piping requires 300 psi, working pressure.
b. Inlet 2 IN NPT, outlet 1/2 IN NPT, unless otherwise shown on the Drawings.
c. Flush accessories:
1) Inlet shut-off valve (ball valve).
2) Blow-off valve.
3) Hose and quick disconnect coupling.
4) Pipe any water discharge to suitable drain.
d. Valves shall be supplied with double acting throttling device.

2.3 PRESSURE-REDUCING VALVES (2 IN AND SMALLER)

A. Water Pressure Regulators:
1. Acceptable manufacturers:
a. Fisher, Type 75A.
b. Mueller, Model H9300.
c. Cla-Val 50-01.
d. Or approved equal.
2. Materials:
a. Body: Bronze.
b. Strainer body: Bronze.
c. Strainer screen: Stainless steel.
3. Design requirements:
a. Self-contained diaphragm operated.
1) Spring loaded.
2) Field adjustable.
b. Strainer: Y-type on supply.
c. Size as shown in Schedule in Section 2.4 or size equal to connecting line size with 125 psi inlet and 50 psi outlet pressure.

B. Air or Gas Pressure Regulators:
1. Acceptable manufacturers:
a. Air service:
1) Fisher 64 Series.
2) Or approved equal.
b. Gas service:
1) Fisher.
2) Or approved equal.
2. Design requirements:
a. Self-contained, diaphragm operated.
1) Spring loaded.
2) Field adjustable.
b. Natural or LP gas service, AGA approved.

2.4 PRESSURE REDUCING VALVES (3 AND 4 INCH)

A. Water pressure regulator:
1. Acceptable manufacturers:
a. Fisher, Type 92W, 6492L.

b. Cla-Val 50-01.
c. Or approved equal.

2. Materials:
   a. Body: Steel.
   b. Cage: Cast iron.
   c. Piston, seat ring and cylinder: 416SS.
3. Design requirements:
   a. Flanged connections.

2.5 PRESSURE RELIEF VALVE (8-INCH OR GREATER)

A. 10" Pressure Relief Valve on Adsorption Clarifier Influent and Raw Water Influent (Bid Alternate B):

1. Valves will be designed to act as pressure relief valves designed to protect the absorption clarifiers and piping upstream of the raw water facilities. They will have a normally closed high pressure pilot designed to open if the pressure exceeds the normal pressure. If there is a pressure rise to 35' on the adsorption clarifier valve or 110' on the raw water influent pressure relief valve, the CRL pilot will open, bringing the valve to full open very quickly. The valve will shut once pressure in the pilot falls below the set point. The setpoint on the pressure relief valves shall be field adjustable from 0-75 psi.
2. The main valve will be ductile iron and have stainless trim internals. It will have a one piece stainless steel seat. It will have an NSF approved fusion bonded epoxy coating. The cover will have a locating lip. The main body will have 150ansi flanged ends rated to 250psi working pressure. The CRL relief pilot will have a 0-75psi spring range. The manufacturer will install a gage on the inlet for monitoring and set up. The valve body will be a globe body style.
3. The manufacturer shall provide a direct factory employee for start up and training.
4. The manufacturer shall provide repair kits for each valve including on for the for the main valve and both pilots as part of the package.
5. The manufacturer shall warranty the valves for 3 years from date of shipment.
6. Both valves shall be 10" Catalog No. 50-01, globe body style, 150 lb pressure class, with suitable trim to prevent cavitation (valve on raw water influent will go from 105' to 0' of head) and withstand corrosion, as manufactured by Cla-Val Co. Newport Beach, CA.

2.6 BACKFLOW PREVENTERS

A. General:
1. Conform to AWWA C511.

B. Acceptable Models:
1. Watts Regulator Company (1/4" - 3") Model 909 M1 QT-S.
2. Watts Regulator Company (4"-10") Series 957 BFG, or Wilkins Model 375A.

C. Materials:
1. Valve Body and Cover: Stainless steel.
2. Elastomers: EPDM.
3. Interior Coating: 12 mils Epoxy.
4. Fasteners: Stainless Steel (304).
5. Check Disc: Reversible silicone.
6. Protective strainer: Bronze Body.

D. Design Requirements:
1. Maximum Pressure Rating: 175 psi.
2. Hydrostatic Test Pressure: 350 psi.
3. Temperature Range: 32°F to 140°F.

E. Accessories:
1. Provide a strainer with 20 mesh screen on supply.

2. Butterfly valves integral with unit.
3. Provide valve air gap and piping to drain.

2.7 SOLENOID VALVES (2 IN AND SMALLER)

A. General Service (Water):
1. Acceptable manufacturers:
   a. ASCO.
   b. Or approved equal.
2. Materials:
   a. Body: Brass.
   b. Seat: Buna-N.
   c. Insulation: Class F.
3. Design requirements:
   a. 110 V AC.
   b. Two-way, normally closed.
   c. Enclosure: Compatible with area classifications indicated on Drawings.
   d. Working pressure, air and water: 125 psig.

2.8 BACKPRESSURE/ANTI-SIPHON VALVE

A. Acceptable Manufacturers:
1. Plast-O-Matic Valves, Inc.
2. RVDM type.
3. Or equal.

B. Materials:
1. Body: PVDF (for NaOH service, use CPVC).
2. Diaphragm: PTFE.
3. Seals: PTFE.

2.9 MUD VALVES

A. General:
1. Mud valves shall be of the iron body, bronze mounted type with non-rising stems, spigot ends, extension stem, nut operator and open by turning counter clockwise. The gate seat shall be rolled into a dovetailed groove under pressure to make one inseparable unit. The seat ring shall be threaded and screwed into place in the frame.
   a. Acceptable manufacturers:
      1) CLOW.
      2) Or approved equal.
   b. Materials:
      1) Valve Body: Cast Iron conforming to ASTM A126 Class B.
      2) Valve stem, stem nut and seats: Bronze.
   c. Design Requirements:
      1) Temperature Range: 32˚F to 140˚F.
      2) Hydrostatic Pressure (with no leakage): 0-10 psi.
   d. Accessories:
      1) Paint exterior of valve in accordance with Section 09905, System 23.

2.10 CORPORATION STOP

A. General:
1. Corporation stops shall be designed to inject chemical into or accept a sample from the center stream of the flow. The unit shall be designed so that the entire injection/sample assembly may be withdrawn from the process line without shutting down or draining the line. Mount corporation stop as specified by the manufacturer. If possible, mount corporation stop from the bottom of the main process line. If the corporation stop is used for sampling, the corporation stop should be mounted from the

top, if possible. Each corporation stop shall be equipped with a ball valve of the same material as the piping system.

B. Materials:
   1. Body: 316 SS
   2. Valve: 316 SS
   3. Gland: 316 SS
   4. Gland Seal: Viton
   5. Ball Check: 316 SS
   6. Check Spring: 316 SS
   7. For CLS Service, use Hastaloy C in place of 316 SS

C. Design Requirements:
   1. Maximum Pressure Rating: 200 psig
   2. Temperature Range: 32 Deg- 300 Deg F
   3. Flow Rate: 26 gph

D. Accessories
   1. SS wire to restrain valve
   2. Injection Check Valve (316 SS or Hasteloy C as in 2.09 B.7)

2.11 PRESSURE SUSTAINING VALVES

A. The Electronic Actuated Pressure sustaining Valve shall maintain a constant upstream pressure and shall be capable of remotely changing this pressure as directed by the hydraulic pressure sustaining pilot and integral electronic actuator.

B. The actuator shall provide the interface between remote telemetry and valve set point control. It shall compare a remote analog signal with an internal position signal in the actuator and adjust the hydraulic pilot spring mechanism to the new setting. The remote analog signal input shall be isolated and reverse polarity protected.

C. A 4-20 mA actuator feedback signal shall be supplied. A second command control input shall be available from dry contact switch closure for clockwise and counter clockwise rotation. The actuator shall be IP-68 rated for submersible service and sized for continuous duty with at least 1200 starts per minute.

D. If power fails, the pilot shall continue to control the main valve to last set point. If remote set point signal is lost, the actuator shall be programmable to stay at last position or go to 4 mA or to 20 mA value of set point range. Default is last position. The actuator shall beranged at the factory to the specific spring range in the pilot control. If other than the default settings are required, these changes shall be accomplished by using only the manufacturer's software and USB cable.

E. Valve shall be sized to handle at least12,500 gpm without adverse effects or cavitation.

F. Valve operation
   1. Valve shall be designed to maintain a set pressure based upon the plant flowrate and the pressure level as measured at the South Fork meter vault. This set pressure will vary only slightly across the range of the plant flows and will be fed to the valve through the 4-20mA signal.
   2. The pressure to sustain shall be initially set to:

Flow (gpm)	Pressure Head at South Fork Venturi Vault (ft)
830	100
1660	99
2490	98
3320	96

4150	93
4980	91
5810	87
6640	84
8300	75

a. Upon setting the initial values, the ranges shall be adjusted to maintain the water level within 10' of the air release valves located near station 115+00 on the raw water line with an approximate elevation of 1908'.
b. The downstream pressure will be based entirely on the level in the rapid mix tank set at approximately 1813. The valve shall handle this loss of head without damage due to cavitation, water velocity, chemical corrosion or solids.
c. Valve operation shall provide for the valve to stay closed until the pressure indicated at the table in (b) is reached, at that point the valve shall open so that the pressure stays at the pressure indicated in the table, but no higher
d. The valve shall be Cla-Val Model 350-02 with 0-75 psi range, globe body, 150 lb pressure class, flanged; valve shall supply feedback signal indicating valve location; valve shall be submersible.

2.12 ACCESSORIES

A. Furnish any accessories required to provide a completely operable valve.

2.13 FABRICATION

A. Completely shop assemble unit including any interconnecting piping, speed control valves, control isolation valves and electrical components.

B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance with AWWA C550.

C. All components shall comply with NSF-61.

2.14 SOURCE QUALITY CONTROL

A. Shop hydrostatically test to unit test pressure.

2.15 MAINTENANCE MATERIALS

A. Provide one set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 — EXECUTION

3.1 INSTALLATION

A. General:
   1. See Section 11005 - *Equipment: Basic Requirements and Section 15100 - Valves: Basic Requirements.*

B. Air Release 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.

C. Back Flow Preventers:
   1. Install with manufacturer recommendation and adequate drainage.

D. Pump Control Valve:
   1. Install with manufacturer recommendation and adequate drainage.

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 15115

WATER CONTROL GATES

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SECTION 15115

WATER CONTROL GATES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sluice gates.
   2. Slide (fabricated) gates.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing Materials (ASTM):
      a. A126, Gray Iron Castings for Valves Flanges, and Pipe Fittings.
      b. A276, Stainless and Heat-Resisting Steel Bars and Shapes.
      c. B32, Solder Metal.
      d. B98, Copper-Silicon Alloy Rod, Bar and Shapes.
      e. B139, Phosphor Bronze Rod, Bar and Shapes.
      f. B209, Aluminum and Aluminum Alloy Sheet and Plate.
      g. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
   2. American Water Works Association (AWWA):
      a. C501, Cast-Iron Sluice Gates.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment.
      b. ICS 6, Enclosures for Industrial Control and System.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and Section 11005 - *Equipment: Basic Requirements.*
   2. Product technical data including:
      a. Acknowledgment that products submitted meet the requirements of standards referenced.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Water control gates:
      a. Rodney Hunt.
      b. Fontaine.
      c. Waterman.

d. Or approved equal.

2. Electric operators:
   a. Auma (Type SA).
   b. Limitorque (Type L120).
   c. Rotork (equal to Type SA or Type L120).
   d. EIM (equal to Type SA or Type L120).
   e. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 SLUICE GATES

A. General: Provide gates, stems, lifts and other appurtenances of size, type, material and construction shown on the Contract Drawings and specified.
   1. Gates meet requirements of AWWA C561 as modified per these Specifications.
   2. Leakage shall be less than 0.05 gpm/foot of seat perimeter with water at top of gate slide and operation in seating position.

B. Material:
   1. Seating faces:
      a. Stainless steel: ASTM A276, Type 304.
   2. Seals: Provide resilient seals for flush bottom gates of neoprene.
   3. Wedges:
      a. Stainless steel: ASTM A276, Type 316.
   4. Anchor bolts, assembly bolts and nuts:
      a. Stainless steel: ASTM A276, Type 304.
   5. Stems and stem couplings:
      a. Stainless steel: ASTM A276, Type 304.

2.3 SLIDE GATES

A. General:
   1. Self-contained slide gates with operators in accordance with the configuration noted in the gate schedule.
   2. Maximum leakage rate: Not to exceed 0.1 gpm per foot of seat perimeter with water at top of gate slide and operating in seating position.

B. Material:
   1. Slide:
      a. Stainless Steel: ASTM A276, Type 304.
   2. Frame, guides, guide rails, cross bars, and head rails:
      a. Stainless Steel: ASTM A276 Type 304.
   3. Anchor bolts:
      a. Stainless steel: ASTM A276, Type 304.
   4. Stems and stem couplings:
      a. Stainless steel: ASTM A276, Type 316.

C. Fabrication:
   1. Frame and guides:
      a. Rigid, welded gate frame and guides: Composed of the guide rails, cross bars, and head rails, with a clear opening the same size as the waterway, unless otherwise specified.
      b. Flatback, spigot back, or embedded type as shown on Contract Drawings.
      c. Construct guides incorporating a dual slot design.
         1) The primary slot will accept the plate of the slide (disc).
         2) The secondary slot will be sufficiently wide to accept the reinforcing ribs of the disc.
      d. Design guides for maximum rigidity: Weight not less than 3 LB per foot.

e. Guides of sufficient length to support two-thirds the height of the slide, when the gate is fully open.
f. Extend the head angle or yoke 42 IN above the operating floor.
g. Provide guides of sufficient strength so that no further reinforcing will be required.
h. Design yoke to support the operating device formed by members welded or bolted at the top of the guides.
i. Design yoke arrangement such that the disc and stem can be removed without disconnecting yoke.
j. Design yoke to support the lift forces when subjected to a load of 80 LB pull on the operator.
k. Design gates with J-seals at the side attached to frame.
l. For embedded type gates provide molded resilient seat mounted at bottom of disc for flush bottom closure and seal against embedded portion of the frame in the channel invert or have a resilient seat mounted on frame flush at channel invert.
m. Design weir gates or downward opening gates with J-seal attached to bottom frame.
n. Design bottom frame member as a minimum of 3 IN of material bearing against slide for weir or downward opening gates.
o. Utilize J-seals and resilient seats of synthetic rubber conforming to AWWA C501.

2. Slide (disc):
a. Plate reinforced slide with structural shapes welded to the plate.
b. Slide cover maximum deflection: 1/360 of the span of the gate under maximum head.
c. Extend reinforcing ribs to guides so that the seating surface of the guide is reinforced.
d. Stem connection of either clevis type, with structural members welded to slide and a bolt to act as pivot pin, or a threaded and bolted (or keyed) thrust nut supported in welded nut pocket.
e. Pocket and yoke of gate capable of taking at least twice the rated thrust output of the operator at 40 LB pull. Slide material same as frame and guides.

3. Stem:
a. Of suitable length and ample strength for the intended service.
b. Stem diameter capable of withstanding twice the rated output of the operator at 40 LB pull, and supported such that L/r ratio for unsupported part of the stem shall not exceed 200.

2.4 GATE OPERATORS AND LIFTS

A. General: Provide lifts in accordance with AWWA C513 or as modified in these Specifications. Provide all lifts with clear butyrate plastic stem cover with Mylar open-close indicator.

B. Manual Operators:
1. Centerline of crank or handwheel approximately 36 IN above operating floor. Unless otherwise shown.
2. Maximum effort of 40 LB on crank or handwheel shall operate gate after unseating gate from wedges bored upon seating head specified.

C. Electric Operators:
1. See Section 15100 - *Valves: Basic Requirements* for electric actuator and control requirements.
2. Gate operation speed: 12 IN per minute.

2.5 ALL GATES, VALVES, OPERATORS AND LIFTS

A. Comply to requirements of Section 11005 - *Equipment: Basic Requirements.*

B. Provide gates, including lift, designed with a minimum factor of safety of five (5). Provide rising stems on all gates.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

A. Installation Check and Start up: Employ and pay for services of the equipment manufacturer's field service representative(s) fully commissioned and authorized by manufacturers to do the following:

1. Inspect equipment covered by these Specifications.
2. Supervise adjustments, calibrations and installation checks and full commissioning.
3. Perform basic operational checks.
4. Provide Owner with a written statement that manufacturer's equipment has been installed properly, lubricated, and calibrated and is ready for operation by the Owner.

B. Field Leakage Test for Slide Gate:

1. Test gate under design seating head and adjust to maximum leakage of 0.1 gpm per foot of seating perimeter.

END OF SECTION

SECTION 15183

PIPE INSULATION

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SECTION 15183

PIPE INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation:
      a. Piping insulation.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 15060 - *Piping: Basic Requirements.*

C. All outside exposed piping, and tankage shall be insulated and heat traced.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (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, 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 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

2. Product technical data including:
   a. Acknowledgment 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. Fiberglass insulation:
      a. Certainteed Corporation.
      b. Manville Corporation.
      c. Owens Corning.
      d. Or approved equal.
   2. PVC jacket:
      a. Ceel-Co.
      b. PIC Plastics.
      c. Or approved equal.

2.2 PIPING INSULATION: FIBERGLASS

A. Pipe and Fitting Insulation:
   1. Preformed fiberglass pipe insulation:
      a. Density: 4 LB/CF.
      b. Temperature rated: 650°F.
      c. Average thermal conductivity not to exceed 0.22 (Btu-IN) per square foot-°F-hour at mean temperature of 75°F.
      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°F 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.
   5. Minimum insulation thickness: Conform to the following schedule or as shown on the Drawings:

Application	Pipe Size	Thickness	Jacket
Low Pressure process air	All	1 IN	Alum

2.3 SUBSTITUTION

A. Submit request for substitution in accordance with Section 01640 - *Product Substitution*.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
   1. Consider ductwork, piping and equipment as exposed, except as otherwise indicated.
   2. 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.
   3. Provide release for insulation application after installation and testing is complete. Apply insulation on clean, dry surfaces after inspection.
   4. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
   5. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures. Provide vapor barrier (0.17 perm-IN; ASTM C355) continuous and unbroken. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
   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. Aluminum pipe jacket:
      a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
      b. Provide smooth and straight joint with a minimum 3 IN overlap.
      c. Secure joints with corrosion-resistant screws spaced 0.25 IN 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 15440

PLUMBING FIXTURES AND EQUIPMENT

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SECTION 15440

PLUMBING FIXTURES AND EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plumbing fixtures, trim, and equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 07900 - Joint Sealants.
   4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
      a. 90.1, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
   2. American Gas Association (AGA).
   3. American Society of Mechanical Engineer (ASME).
   4. American Society of Sanitation Engineers (ASSE):
      a. 1011, Performance Requirements for Hose Connections Vacuum Breakers.
   5. National Sanitation Foundation (NSF).
   6. Underwriters Laboratories, Inc. (UL).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements and Section 15060 - Pipe and Pipe Fittings: Basic Requirements.*
   2. Color selection charts for Owner color selection.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Praduct Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Emergency shower and eye wash:
      a. Speakman.
      b. Haws.
      c. Or approved equal.
   2. Drains, roof drains, carriers, and shock absorbers:
      a. Wade.
      b. Josam.
      c. Zurn.
      d. Smith.
      e. Or approved equal.
   3. Hydrants:
      a. Wade.
      b. Josam.

c. Smith.
d. Or approved equal.

4. Water softener:
   a. Culligan.
   b. Or approved equal.
5. Reduced pressure backflow preventer:
   a. Watts.
   b. Febco.
   c. Clayton.
   d. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 MANUFACTURED UNITS

A. Emergency Fixtures:
1. Emergency shower:
   a. Deluge shower head:
      1) Self-closing ball valve.
      2) Pull-chain.
   b. Eye/face wash:
      1) Aerated eye-face wash with stainless steel bowl.
      2) Stay-open full port ball valve.
      3) Push handle control for eye-face wash.
      4) Supply line strainer for eye-face wash.
   c. Type:
      1) ESEW-1 (free standing, cast flange base and pull-chain for shower): Speakman SE-601.
      2) ESEW-2 (freezeproof, wall mounted, and push handle for shower): Speakman SE-242 and SE-403.
      3) Freezeproof, outside installation: Speakman SE-609, with freeze proof valve.

B. Carriers:
1. Closets (wall hung):
   a. Wade W-330 or 340 for vertical stacks.
   b. Wade W-310, 4 IN for horizontal lines.
2. Urinals: Wade W-400 series.
3. Lavatories: Wade W-520 series.
4. Drinking fountains (electric water coolers): Wade W-400 series.
5. Service sinks: Wade W-630.

C. Drains, Roof Drains and Downspout Nozzle:
1. Floor drain:
   a. Cast-iron body.
   b. Bottom outlet.
   c. Clamping seepage flange.
   d. Seepage openings.
   e. Size as shown on Drawings.
   f. Type:
      1) FD-1 (unfinished area) sediment bucket, bucket shall support grate: Wade W-1200-TD.
      2) FD-2 (finished area) adjustable satin nickel bronze strainer: Wade W-1100.
      3) FD-3 (finished area with tile floor) adjustable satin nickel bronze square strainer: Wade W-1100-G.
      4) If FD is specified, provide FD-2 type.
2. Equipment drain:
   a. Cast-iron soil pipe.
   b. Type:
      1) ED-1: Refer to Contract Drawings.

2) ED-2: Refer to Contract Drawings.

3. Roof drain:
   a. Bottom outlet cast-iron drain with flashing clamp, removable mushroom-type dome and deck clamp.
   b. Provide cast-iron extension flange (-DF) where insulation thickness exceeds 2 IN.
   c. Type:
      1) RD-1: Wade W-3000.
      2) RD-2: Wade W-3000-D, 2 IN dam.
4. Downspout nozzle:
   a. Cast bronze downspout.
   b. Wade W-3940.

D. Traps:
1. Floor and equipment drains:
   a. Same material and coating as the piping system.
   b. 3 IN minimum seal.
2. Fixture drains:
   a. 2 IN minimum seal.
   b. Cast brass.
   c. Chrome plated.
   d. Size as required.
3. Ventilation housing drains:
   a. Extra-deep seal sufficient to maintain seal against static pressure maintained in fan housing.

E. Cleanouts:
1. Cleanouts:
   a. Cleanouts for cast-iron pipe:
      1) Tapped extra heavy cast-iron ferrule.
      2) Calked into cast-iron fittings.
      3) Extra heavy brass neoprene seal screw plug with solid hexagonal nut.
   b. Cleanouts for steel pipe:
      1) Extra heavy brass screw plug in drainage fittings.
   c. Cleanouts turning out through walls and up through floor shall be made by long sweep ells or "y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room.
      1) Where definite finish is not indicated, wall plates shall be chrome-plated cast-brass and floor plates polished brass.
   d. Clean out openings on downspouts, waste and drain lines as indicated and as required by Code.
      1) Provide cleanouts of same size as pipe up to 4 IN, and not less than 4 IN for larger pipes.
      2) Close access openings for concealed cleanouts with flush floor or flush wall cover plates or flush ceiling access panels.
      3) Provide wall plates with chrome plated cast-brass round Clean out cover with flanged ring.
      4) Provide screws which match cover plate material.
   e. Cleanouts installed in floor with a resilient tile finish: Wade W-6000-TB.
   f. Cleanouts installed in floor with ceramic tile, concrete, or Terrazzo finish: Wade W-6000-SB.
   g. Cleanouts installed in finished rooms flush with wall: Wade W-8460-S stainless steel.
   h. Cleanouts installed in completely accessible pipe chases or where piping is exposed do not require special covers.
   i. Cleanouts in floating floors: Smith 9350-C2.

F. HB-1 Hose Bibb:
1. 3/4 IN boiler drain with attached vacuum breaker-backflow preventer.

2. Vacuum breaker: non-removable, manual draining, meeting the requirements of the ASSE 1011.

G. Hydrants:
1. Wall hydrant:
a. Non-freeze.
b. Integral vacuum breaker.
c. Nylon seat.
d. 3/4 IN hose connection.
e. 3/4 IN inlet connection.
f. Length as recommended by manufacturer for wall thickness.
g. Type:
1) WH-1 (exposed) Wade W-8620.
2) WH-2 (wall box) Wade W-8625.
2. Yard hydrant:
a. Non-freeze.
b. Galvanized casing.
c. Bury depth per Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
d. Brass mechanism.
e. Type:
1) YH-1 Woodford Model 53, 3' bury depth.

H. Water Meter:
1. As indicated of a type approved by Water Department.
a. Coordinate meters furnished by Water Department as to type and size.
b. Obtain and pay necessary permits and approvals required to complete installation of water service.
c. Provide valve on each side of meter and 3/4 IN drain valve spilling over floor drain.
2. Install full sized bypass line around meter with a sealed valve approved by Water Department.
a. Meters 2 IN and less: Threaded fittings.
b. Meters 2½ IN and larger: Flanged connections.

I. Domestic Hot Water Circulating Pump:
1. Pump casing and impeller: Bronze, designed for domestic water circulating.
2. Provide pump as scheduled.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Cross Connection:
1. Do not install any plumbing components that will provide a cross connection between potable and non-potable or drainage systems.

B. Fixtures:
1. Install fixtures at locations indicated on Drawings and in compliance with local codes.
2. Connect plumbing supply, drain and vent line sizes as shown on Drawings.
3. Set proper grounds to form secure base for each fixture and rigid setting.
4. Install fixtures except water closets with water supply above rim and with code approved backflow preventers.
5. Seal fixture joints abutting walls and floors with silicone sealant.
6. Connect exposed traps and supply pipes for fixtures and equipment to rough piping systems at wall, unless otherwise specified.

C. Drains:
1. Install drains at locations indicated on Drawings and in compliance with local codes.
2. In quarry tile floors:
a. 24 IN x 24 IN 6 LB lead sheet clamped to drain.

b. Set 1½ IN above structural slab for mortar set and 1/2 IN for thin set.
3. In uncovered concrete slabs:
a. Install at the low points of surface areas to be drained or as indicated.
b. Set tops of drains flush with the finished floor.
c. Install drain flashing collar or a flange so that no leakage occurs between the drain and the adjoining surfaces.
d. Maintain the integrity of waterproof membranes, where penetrated.

D. Wall Hydrants:
1. Install 24 IN above exterior grade.
2. Support units from the structure and mount flush with structure face.
3. Prior to final setting, fill the back of the face with a non-hardening silicone calk and press firmly in place to stop infiltration and water leakage.
4. Install isolation valves in line to each wall hydrant.

E. Yard Hydrants:
1. Install plumb.
2. Set cover flush with the concrete support.
3. Where installed in a grass area, provide concrete around the cover area 6 IN larger than the cover and 4 IN deep.
4. Install 1/2 CY of 1½ IN nominal rock under the valve for water drain back.

F. Hose Bibs:
1. Install 36 IN above finished floor.
2. In exterior locations, provide interior isolation valve.

G. Shock Absorbers:
1. Install on hot and cold water lines adjacent to each battery of fixtures or other equipment where indicated on Drawings.
2. Size as recommended by manufacturer for length of pipe served.
3. Locations having two fixtures or less, install capped air chamber 12 IN long on hot and cold water runouts to each fixture, same size as runout.
4. Runouts to hose bibbs and wall hydrants do not require air chambers.
5. Install units vertically on top of pipe or as detailed on the Drawings.

H. Cleanouts:
1. Install cleanouts:
a. Above floor in each vertical riser that connects to horizontal branch below floor.
b. At test tee to receive proper test plugs in each vertical riser at least every other floor.
c. As required by local code.

3.2 FIELD QUALITY CONTROL

A. Test piping and fixtures for leaks per Section 15060 - *Pipe and Pipe Fittings: Basic Requirements*.

B. All components shall comply with NSF-61.

END OF SECTION

SECTION 15510

FIRE HYDRANT

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SECTION 15510

FIRE HYDRANT

1.1 SUMMARY

A. Section Includes:
1. Dry-barrel fire hydrant.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 09905 - Painting and Protective Coatings.
4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

C. Allowances:

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Waterworks Association (AWWA):
   a. C502, Dry-Barrel Fire Hydrant.
   b. M17, Installation, Operation and Maintenance of Fire Hydrants.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 01340 - Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.
2. Product technical data:
   a. Acknowledgment that products submitted meet the requirements of the standards referenced.
   b. Manufacturer's installation instructions.
   c. Acknowledge and verify dimensions and provide list of integral parts and materials.

B. Operation and Maintenance Manuals:
1. See Section 01340 - Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers and models are acceptable:
1. Mueller Super Centurion 200 5 ¼ inch
2. American Flow Control B-84-B 5 ¼
   a. Submit request for substitutions in accordance with Section 01640 - *Product Substitution.*

2.2 FIRE HYDRANT

A. General:
1. Conform to AWWA C502, latest revision.
2. Provide with either compression or gate design.
3. Provide with a 5 IN valve opening, nozzle section consisting of 2½ IN hose nozzles and one 4½ IN steamer.
4. Provide with water passages to permit full flow of water to minimize friction loss.

5. Furnish with multiple weep holes for positive draining to allow water to escape readily from standpipe when hydrant valve is closed.
6. Designed to throttle flow when partially opened.
7. Designed to allow removal of valve and valve stem without digging up hydrant.
8. Suitable for 5 FT of bury.
9. Furnish with mechanical (gland type) joint inlet connections.
10. Design to break off at ground line when struck by a vehicle.
11. Furnish with O-ring packing only.
12. Furnish hose and steamer nozzles with threads conforming to standard threads used by local Fire Department.
13. Furnish with direction of opening as required by local Fire Department with direction of opening cast on dome.
14. Fire hydrants shall be connected to the main utilizing a mechanical joint and the entire assembly shall include a separate gate valve which may be used to shut off the fire hydrant.
15. Hydrants shall be 5 ¼ inch with with two (2) 2 ½ inch hose outlets and a single 5 ¼ inch steamer pump outlet.
16. Hydrants shall be designed for a minimum working pressure of 200 psig but shall remain functional and not sustain structural damage when subjected to a hydrostatic pressure of 400 psig.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install hydrants at locations indicated in accordance with AWWA M17 and the following:
1. Remove foreign material from barrel of hydrant before placement.
2. Install plumb and at same elevation as connecting pipe and main.
3. Place each hydrant on a slab of concrete not less than 6 IN thick and 18 IN SQ.
4. Block backside of hydrant, opposite pipe connection, with concrete firmly wedged between hydrant and vertical face of undisturbed trench.
5. Place a minimum of 7 CF of crushed stone around base of hydrant.
6. Firmly tamp select backfill around hydrant to surface of ground and to a distance of 5 FT in front of hydrant.

3.2 COATINGS AND FINISHES

A. Provide hydrant with below grade and above grade coatings as per Section 09905 - *Painting and Protective Coatings*.
1. Paint above grade with color conforming to the requirements of the local Fire Department.

END OF SECTION

SECTION 15605

HVAC: EQUIPMENT

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SECTION 15605

HVAC: EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Heating, ventilating, and cooling equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Division 16 - Electrical.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Gas Association (AGA).
   2. Air Movement and Control Association (AMCA):
      a. 210, Laboratory Methods of Testing Fans for Rating Purposes.
      b. AS401, Fans, Standard Classifications for Spark-Resistant Construction.
   3. Air Conditioning and Refrigeration Institute (ARI):
      a. 410, Force-Circulation Air-Cooling and Air-Heating Coils.
      b. 430, Central Station Air-Handling Units.
   4. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
      a. Applications Handbook, Chapter on Sound and Vibration Control.
   5. National Electrical Manufacturers Association (NEMA).
   6. National Fire Protection Association (NFPA):
      a. 90A, Installation of Air Conditioning and Ventilating Systems.
   7. National Roofing Contractor Association (NRCA).
   8. Underwriters Laboratories, Inc. (UL).

B. Miscellaneous:
   1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
   2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*
   2. Fabrication and/or layout drawings.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Wiring diagrams.
      d. Control diagrams.
      e. Manufacturer's catalog cuts and technical data.
      f. Corrosion-protection information.
      g. Fan curves.
      h. Sound data.
      i. Vibration isolation.
      j. Control description.
      k. Performance data on all equipment.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Split system heating/cooling units:
      a. Carrier.
      b. Trane.
      c. Or approved equal.
   2. Wall-mounted propeller-type exhaust fans:
      a. Greenheck.
      b. Aerovent.
      c. Penn Ventilator Co., Inc.
      d. Buffalo Forge.
      e. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 GENERAL

A. All manufactured units shall be factory wired and assembled.
   1. Use fasteners made of same material as unit.
   2. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
      a. Type: As per Table 34, Chapter 42, ASHRAE Applications Handbook.
      b. Maximum allowable vibration: Table 33, Chapter 42, ASHRAE Applications Handbook.

B. All manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.

2.3 MANUFACTURED UNITS

A. Split system heating/cooling units:
   1. Cooling coils - direct expansion:
      a. ARI certified.
      b. Material:
         1) Aluminum.
         2) Copper with aluminum fins for use in administration units only.
      c. Fin spacing: Minimum 80 fins per foot.
      d. Minimum standard operating limit: 250 psi.
      e. Capacity as scheduled.
   2. Indoor unit:
      a. Materials:
         1) Casing: Heavy gage steel.
         2) Framework: Steel angle.
         3) Pan insulation: Foam-in-place insulation.
         4) Casing insulation: 1 IN, 3/4 LB fiberglass blanket.
      b. Casing:
         1) Sectionalized construction.
         2) Removable access panels.
         3) Insulated weatherproof casing.
      c. Evaporator fans:
         1) Double-width, double-inlet centrifugal type.
         2) Forward curved or airfoil.

3) Solid steel shafts.
4) 200,000 HR relubricative ball-bearings.

d. Fan motors:
1) Relubricative ball-bearings.
2) Variable pitch sheave.
3) Adjustable base.

e. V-belts and drives sized for 150-percent motor capacity.

f. Isolated fan assembly.

g. Filter section:
1) Filters: See Section 15890 - *HVAC: Ductwork*.
2) Access doors for filter removal.

h. Evaporator coil circuiting:
1) Adjustable thermal expansion valve per circuit with external equalizer.
2) Combination row/split face circuiting.

i. Drain pan:
1) Mastic-coated.
2) Threaded drain connections.

j. Propane fired heating section:
1) Built-in static-pressure airflow switch.

k. Size and capacity as scheduled on Drawings.

3. Air-Cooled Condensing Units - Split System:

a. ARI rated.

b. UL listed.

c. Materials:
1) Casing: Galvanized steel.
2) Mounting/lifting rails: Steel.
3) Outdoor coil: Seamless aluminum tubing and aluminum fins.
4) Fan blades: Aluminum.

d. Weatherproof casing with access panels.

e. Compressor:
1) Hermetically sealed.
2) Internal pressure protector.
3) Crankcase heater.
4) Internal spring mounts.
5) Centrifugal oil pump.
6) Built-in overload protection.

f. Condenser fans and motors:
1) Vertical discharge.
2) Direct drive.
3) Statically and dynamically balanced.

g. Built-in refrigerant filter dryer.

h. Built-in liquid line and gas line service valves with gage ports.

i. Outdoor coil:
1) Fins mechanically bonded to tubing.
2) Lab tested to 2000 psi.

j. 24 V factory-wired controls to include fusing and control power transformer.

k. Size and capacity as scheduled on Drawings.

B. Wall-Mounted Propeller-Type Exhaust Fans:

1. AMCA certified.

2. Industrial quality.

3. Materials:

a. Propeller: Cast aluminum or aluminum.

b. Office ring: Spun aluminum.

c. Panel and supports: Aluminum or stainless steel.

d. Drive shaft: Solid stainless steel.

e. Sheaves: Cast iron.

4. Propellers:
    a. Statically and dynamically balanced.
    b. Airfoil design.
    c. Minimum four blades.
5. Sealed pillow block bearings.
6. Welded reinforced motor base plate.
7. Adjustable motor base.
8. Driver and driven sheaves:
    a. Keyed hub type.
    b. Drive sheaves: Fixed pitch diameter.
    c. Driver:
        1) Shipped with variable pitch diameter sheave.
        2) Fixed pitch diameter size based on approved test and balance reports.
        3) V-belt drives sized for 150-percent motor horsepower.
9. Accessories:
    a. Inlet guard.
    b. Outlet guard.
    c. Heavy-duty automatic shutter.
    d. Mounting adapter.
    e. Bird screen.
10. Size and capacity as scheduled on Drawings.

PART 3 – EXECUTION

3.1 ADJUSTING

A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION

SECTION 15620

HVAC: INSULATION

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SECTION 15620

HVAC: INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*
   4. Section 16890 - *Ductwork.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   3. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
   4. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
   5. ASTM E84 - Surface Burning Characteristics of Building Materials.
   6. ASTM E96 - Water Vapor Transmission of Materials.
   7. NFPA 255 - Surface Burning Characteristics of Building Materials.
   8. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
   9. UL 723 - Surface Burning Characteristics of Building Materials.

B. Qualifications:
   1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type and size required, whose products have been in use in similar service for not less than three (3) years.
   2. Installers: Firm with at least five (5) years installation experience on products similar to that required for this Project.
   3. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

C. DELIVERY, STORAGE, AND HANDLING
   1. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
   2. Store insulation in original wrapping and protect from weather and construction traffic.
   3. Protect insulation against dirt, water, chemical, and mechanical damage.
   4. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
   5. Maintain temperature during and after installation for minimum period of 24 hours.

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. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*

2. Product Data: Provide product description, list of materials and thickness for each service, and locations.
3. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

B. Operation and Maintenance Manuals:
1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Insulation:
a. Owens-Corning.
b. Knauf.
c. Manville.
d. Certain-Teed.
e. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 COMPONENTS

A. Glass Fiber, Flexible:
1. Insulation: ASTM C553; flexible, noncombustible blanket.
a. 'K' ('Ksi') value : ASTM C518, 0.31 at 75 degrees F (0.045 at 24 degrees C).
b. Maximum service temperature: 250 degrees F (121 degrees C).
c. Maximum moisture absorption: 0.20 percent by volume when tested for 96 hours at 120 degrees F and 95 percent relative humidity.
d. Density: 0.75 lb/cu ft (12 kg/cu m).
2. Vapor Barrier Jacket:
a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
b. Moisture vapor transmission: ASTM E96; 0.04 perm.
c. Secure with pressure sensitive tape.
3. Vapor Barrier Tape:
a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
4. Tie Wire: Annealed steel, 16 gage (1.5 mm).
5. Rating: Provide insulation having flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM e84 (NFPA 255) method, labeled by the manufacturer. The label shall indicate the insulating value, flame spread and smoke-developed rating.

B. Glass Fiber, Rigid:
1. Insulation: ASTM C612; rigid, noncombustible blanket.
a. 'K' ('Ksi') value : ASTM C518, 0.23 at 75 degrees F.
b. Maximum service temperature: 450 degrees F (232 degrees C).
c. Maximum moisture absorption: 1 percent by volume when exposed to air at 120 degrees F and 95 percent relative humidity for 96 hours.
d. Density: 3 lb/cu ft (48 kg/cu m).
2. Vapor Barrier Jacket:
a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
b. Moisture vapor transmission: ASTM E96; 0.02 perm.
c. Secure with pressure sensitive tape.

3. Vapor Barrier Tape:
   a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
4. Rating:
   a. Provide insulation having flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM e84 (NFPA 255) method, labeled by the manufacturer. The label shall indicate the insulating value, flame spread and smoke-developed rating.

PART 3 — EXECUTION

3.1 INSTALLATION

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Insulation:
1. Examination:
   a. Verify that ductwork has been tested and approved before applying insulation materials.
   b. Verify that surfaces are clean, foreign material removed, and dry.
2. General Installation:
   a. Install materials in accordance with manufacturer's instructions.
   b. Provide insulation with vapor barrier jackets.
   c. Finish with tape and vapor barrier jacket.
   d. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   e. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
3. For exterior applications, provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
4. External Duct Insulation Application:
   a. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   b. Secure insulation without vapor barrier with staples, tape, or wires.
   c. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
   d. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   e. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
5. Install flexible ductwork only on flexible duct sections of ductwork conveying outdoor air into the building.
   a. Join neatly to equipment and to rigid sections of ductwork.
   b. Allow min of 1 IN slack to allow vibration of equipment.
6. Install rigid insulation on ductwork conveying outdoor air into the building.
7. Maintain access to adjustment devices such as dampers, blades, etc.; provide access neatly through insulation; tape back edges of insulation to identify device handle in accessible and visible location.
8. Specifics of Installation:
   a. Coordinate final path of ductwork and accessory installation prior to insulation installation. Identify space available, potential obstructions, required access and maintenance space, and coordinate with structure and ductwork top obtain the best possible insulation methods, prior to start of work.
   b. Install a fully insulated system, including any repair to existing systems that are disturbed under the scope of this project; major items and general routing are indicated on drawings.
   c. Ductwork sizes and routing indicated are based on basic knowledge of the existing and new space conditions and structure. Coordinate final insulation requirements to accommodate final size and routing of ductwork systems.

d. Maintain insulation through wall, ceiling, floor, and other penetrations; provide physical barrier to prevent damage or undue compression of installed insulation. Insulation shall be continuous through wall or ceiling openings and sleeves; vapor barrier jacket shall be applied with a continuous, unbroken vapor seal and all joints shall be sealed with a vapor barrier adhesive unless otherwise indicated

e. Install in accordance with MFR recommendations using only adhesives, mastics and mechanical fasteners approved by the insulation MFR.

f. Insulation shall not be applied until after the equipment has been tested with results acceptable to the Engineer.

g. Staples, stick clips, and hangers shall be vapor sealed where they puncture vapor barrier jackets. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

h. Insulation damaged at any time prior to final acceptance, shall be repaired with insulation and sealant as specified for new work.

END OF SECTION

SECTION 15890

HVAC: DUCTWORK

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SECTION 15890

HVAC: DUCTWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HVAC ductwork and accessories.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - *Equipment: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Engineerural Manufacturer's Association (AAMA):
      a. 605.2, Voluntary Specification for High Performance Organic Coatings on Engineerural Extrusions and Panels.
   2. Air Diffusion Council (ADC):
      a. 1062, Test code for Grilles, Registers and Diffusers.
   3. Air Movement and Control Association (AMCA):
      a. 210, Test Code for Air Moving Devices.
      b. 500, Test Method for Louvers, Dampers, and Shutters.
   4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. Handbook of Fundamentals, Chapter 33, Duct Design.
      b. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for Removing Particulate Matter.
      c. 70, Method for Testing for Rating the Air Flow Performance of Outlets and Inlets.
   5. American Society for Testing and Materials (ASTM):
      a. A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
      b. B209, Aluminum-Alloy Sheet and Plate.
      c. B221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
      d. D3299, Filament Wound Glass Fiber Reinforced Thermoset Resin.
   6. American Welding Society (AWS).
   7. National Fire Protection Association (NFPA):
      a. 90A, Installation of Air Conditioning and Ventilating Systems.
   8. National Bureau of Standards (NBS):
      a. Voluntary Product Standard PS_15.
   9. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
      a. Ducted Electrical Heat Guide for Air Handling Systems.
      b. HVAC Duct Construction Standards - Metal and Flexible.
   10. Underwriters Laboratory, Inc. (UL):
      a. Building Materials Directory.
      b. 555, Fire Damper and Ceiling Fire Damper.

B. Qualifications:
   1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type and size required, whose products have been in use in similar service for not less than three (3) years.
   2. Installers: Firm with at least five (5) years installation experience on products similar to that required for this Project.

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. Shop Drawings:
   1. See Section 11005 - *Equipment: Basic Requirements.*
   2. Scaled ductwork drawings (1/4 IN equals 1 FT) showing duct and accessory layout and support.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Grilles:
      a. Anemostat.
      b. Carnes.
      c. Titus.
      d. Or approved equal.
   2. Duct sealers:
      a. Chicago Mastic.
      b. 3M Co.
      c. Permatex.
      d. Benjamin Foster.
      e. Or approved equal.
   3. Louver/Damper combination units:
      a. Ruskin.
      b. Vent Products.
      c. Or approved equal.
   4. Volume dampers:
      a. Ruskin.
      b. Or approved equal.
   5. Flexible duct/equipment connections:
      a. Vent fabrics.
      b. Duro-Dyne.
      c. Or approved equal.
      d. American Warming.
      e. Or approved equal.

B. Submit requests for substitution in accordance with Section 01640 - *Product Substitution.*

2.2 COMPONENTS

A. Duct and Fittings (Metallic):
   1. Materials: 3003 I_H_14 aluminum alloy.
   2. Fabrication:
      a. Ducts with largest side or diameter to 30 IN: 0.05 IN thick.
      b. Meet SMACNA HVAC Duct Construction Standards for minimum of 2 IN water gauge static pressure.

c. Ductwork shall be fully sealed and mechanically connected together. Provide duct sealing compound UL classified with flame/spread rating of 20 or less at all seams and joints.

B. Supports and Hangers:
   1. Materials:
      a. Support angles: Aluminum or stainless steel,1/8 inch X 1 inch minimum in size.
      b. Hanger rods: Stainless steel.
      c. Anchors: Stainless steel wedge type.
      d. Provide stainless steel hardware in damp or corrosive environments.
   2. Fabrication:
      a. Trapeze type units.
   3. Location:
      a. Locate supports on ductwork no more than 4 feet apart on center, and within 2 feet of each termination and transition of duct section. Provide supports within 1 foot on each side of duct-mounted equipment, such as in-line fan units.

C. Flexible Connections:
   1. Materials: Hypalon, double coated closely woven glass fabric.
   2. Fabrication:
      a. Withstand 4.5 IN water column, positive and negative pressure.

D. Air Grille and Register Assembly:
   1. Materials:
      a. Assembly: Stainless Steel.
      b. Gaskets: Sponge rubber.
   2. Fabrication:
      a. Supply registers:
         1) Two sets of individually adjustable louvers, set 90 degrees to one another (double deflection style).
      b. Exhaust and return registers:
         1) 35 degree deflection front blades (single deflection).
      c. Dampers:
         1) Key-operated opposed blade.
      d. Screws, duct collars, and transitions as required.
      e. Provide brushed stainless steel finish in exposed locations.
      f. Provide with volume damper and opposed blade damper at each outlet and inlet.

E. Combination Louver/Damper assemblies:
   1. Storm proof.
   2. Continuous blade appearance.
   3. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
   4. Minimum free area: 45%
   5. Maximum pressure drop: 0.10 IN of water at 900 fpm at zero water penetration.
   6. Bird screen:
      a. 1/2 IN SQ mesh.
      b. 16 GA aluminum.
      c. Install in standard, folded frame.
   7. Insect screen:
      a. 1/16 IN SQ mesh.
      b. 16 GA aluminum.
      c. Install in standard, folded frame.
   8. Anchors, fasteners, reinforcing: Aluminum or stainless steel.
   9. Finish:
      a. AAMA 605.2.
      b. AA_M10C22A42 dark bronze anodized finish, or other color as coordinated with Engineer.
      c. Provide complete trim package for both sides of wall in which louver is installed, for finished appearance on both sides of wall.

PART 3 — EXECUTION

3.1 INSTALLATION

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Metal Ductwork:
   1. Install with longitudinal seams sealed for zero leakage.
      a. Welded seams may be used upon acceptance of welded seam samples by Engineer.
   2. Install gaskets at each transverse joint and fasten sections together with bolts.
      a. Tighten for zero leakage.
   3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
   4. Install turning vanes in square elbows.
      a. Unsupported vane length not to exceed 48 IN.
      b. Position vanes at proper angle to meet specified pressure drop.
   5. Install flexible connections at fans.
      a. Locate as close as possible to fan.
      b. Allow min of 1 IN slack to prevent vibration transmission.
      c. Install thrust restraints across connectors.
   6. Install access doors where required, and at smoke and fire damper in accordance with NFPA requirements. Provide access door on both sides of duct devices that may be adjusted.
   7. Maintain access to adjustment devices such as dampers, blades, etc.; provide access neatly through insulation and locate handle or device in accessible and visible location.
   8. Volume dampers/extractors:
      a. Install at supply registers, grilles, diffusers and supply branch connections from ducts.
      b. Provide branch duct extensions into main duct above and below extractor when branch duct is narrower than main duct.
      c. Install at exhaust registers and branch connections from ducts.
   9. Installation:
      a. Coordinate path and height of ductwork and accessory installation prior to fabrication of ductwork. Identify space available, potential obstructions, required access and maintenance space, and coordinate with structure and Engineer the best possible path and mounting height, prior to start of work.
      b. Install a fully operational and complete system, including any repair to existing systems that are disturbed under the scope of this project; major items and general routing are indicated on drawings.
      c. Piping and ductwork sizes and routing indicated are based on basic knowledge of the existing space conditions and structure. Coordinate actual routing in field such that all existing and new piping, ductwork, structural elements, equipment, lighting, and other potential obstructions are considered and accommodated prior to starting the fabrication or installation. Actual routing specifics shall be field determined such that all ductwork shall be run concealed and parallel to building lines. Contractor shall provide all cutting, patching, and repair work as required for complete project installation, except where such cutting violates existing warrantees held by the Owner for roofing or other systems. Structural members shall not be cut for installation of ducts.
      d. All floors, walls, roofs, and ceilings that must be penetrated for installation shall be sealed and finished to meet original condition of surface, and routing/locations shall be fully coordinated with Owner prior to start of work. Coordinate with Owner for flashing and roof repair - Owner may require separate roofing Contractor to maintain warranty of roofing material. All penetrations of fire-rated materials shall be sealed to maintain the rating; coordinate with Engineer for fire rated material locations.

C. Air Grille and Register Assemblies:
   1. Install where shown on Drawings, in size and capacities scheduled on Drawings.

2. Adjust airflow of each terminal air device to yield scheduled airflows on Drawings.
3. Coordinate inlets and outlets with space eqpt, ductwork locations, ceiling tile, lighting fixtures, and other nearby devices and equipment, and balance to supply or return the indicated airflow values. Connect registers and diffusers to ductwork using rigid duct connections of same diameter as register/diffuser neck.

END OF SECTION

SECTION 15990

HVAC SYSTEMS: BALANCING AND TESTING

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SECTION 15990

HVAC SYSTEMS: BALANCING AND TESTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Testing, adjustment, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.
3. Sound measurement of equipment operating conditions.
4. Vibration measurement of equipment operating conditions.

B. Related Sections include but are not necessarily limited to:
1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.
3. Section 11005 - *Equipment: Basic Requirements.*
4. Section 15605 - *HVAC: Equipment.*
5. Section 15970 - *Instrumentation and Control for HVAC Systems*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. Air Diffusion Council (ADC):
   a. 1062, Test code for Grilles, Registers and Diffusers.
2. Air Movement and Control Association (AMCA):
   a. 500, Test Method for Louvers, Dampers, and Shutters.
3. National Fire Protection Association (NFPA):
   a. 70 - National Electric Code
   b. 90A, Installation of Air Conditioning and Ventilating Systems.
4. National Bureau of Standards (NBS):
   a. Voluntary Product Standard PS_15.
5. Underwriters Laboratory, Inc. (UL):
   a. Building Materials Directory.
   b. 555, Fire Damper and Ceiling Fire Damper.
6. NEMA DC 3 - Low-Voltage Room Thermostats.
7. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
8. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.
9. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
10. AABC - National Standards for Total System Balance.

B. Qualifications:
1. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section, with at last five (5) years of experience in similar systems. The testing, adjusting and balancing company shall not be affiliated in any way with the contractor, equipment suppliers or installers.
2. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, registered Professional Engineer experienced in performance of this Work and licensed in the State.

C. Quality Assurance:
1. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE 111, or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
2. Maintain one bound copy of reference document on site.

1.3 SUBMITTALS

A. Assurance/Control Submittals:
   1. Test Reports: Submit the following reports to Engineer directly from Testing Laboratory, with copy to Contractor.
      a. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
      b. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for inclusion in operating and maintenance manuals.
      c. Provide reports in binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations, with reference to equipment served.
      d. Indicate data on AABC National Standards for Total System Balance forms.
   2. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
   3. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

C. Project Record Documents: Accurately record the following:
   1. Actual locations of control components, including panels, thermostats, balancing valves, and sensors, and the approximate setting of each. Indicate temperature settings and airflows at each air inlet and outlet.
   2. Special Warranty: Submit written special warranty with forms completed in Owner's name and registered with manufacturer as specified in this Section.

PART 2 – PRODUCTS

2.1 TEST AND BALANCE AGENCIES

A. Subject to compliance with project requirements, Testing Agencies within 100 miles of Project site, that regularly perform specified services.

B. Submit requests for Agency use in accordance with Section 01640 – *Product Substitution.*

PART 3 – EXECUTION

3.1 EXAMINATION

A. See Section 11005 - *Equipment: Basic Requirements.*

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work. Report in writing the prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

D. Coordinate installation of system components with installation of mechanical systems equipment such as fan units and heating units.

3.2 TESTING

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Duct systems are clean of debris.
   5. Fans are rotating correctly.
   6. Volume dampers are in place and open.
   7. Air coil fins are cleaned and combed.
   8. Access doors are closed and duct end caps are in place.
   9. Air outlets are installed and connected.
   10. Duct system leakage is minimized.
   11. Equipment is securely mounted to structure.
   12. Gas piping and systems have been inspected and approved for use.
   13. Filters are new and clean.

B. Test via Standards Referenced.

C. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

A. Air Moving Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Heating Units: Adjust heating output via thermostat setpoint to within plus 10 percent and minus 5 percent of design for space.

3.5 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings. Repair insulation disturbed due to inspection and testing.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Contracting Officer.

F. Check and adjust systems approximately six months after final acceptance and submit report.

3.6 AIR SYSTEM PROCEDURE

A. Adjust fan systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust dampers of exhaust and distribution systems to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by internal duct devices.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

END OF SECTION

SECTION 16010

ELECTRICAL - GENERAL REQUIREMENTS

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SECTION 16010

ELECTRICAL - GENERAL REQUIREMENTS

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for electrical work.

B. Install and wire all equipment, including pre-purchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specifications and ensure that equipment is ready and safe for energization.

C. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Division 2 - Site Construction.
   3. Section 09905 - *Paint*.
   4. Division 11 - Equipment.
   5. Division 15 - Mechanical.

D. Drawings Use and Interpretation:
   1. Drawings indicate the location and arrangement of electrical equipment and the approximate location of other equipment requiring electrical work.
      a. For exact locations of building elements, refer to dimensioned architectural/structural drawings.
      b. Field measurements take precedence over dimensioned drawings.
   2. Electrical drawings are used to indicate area classifications.

E. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination drawings.

F. Dimensions indicated for electrical equipment and dimensions indicated for the installation of electrical equipment are restrictive dimensions.

1.2 AREA CLASSIFICATIONS

A. Classification of an area will determine the NEMA rating of the electrical equipment enclosures to be used in that area. Selection of electrical equipment enclosures shall be based on the following criteria:
   1. Locations may be classified as Wet, Corrosive or Hazardous.
      a. For Wet locations all electrical equipment enclosures shall be NEMA 4.
      b. For Corrosive locations all electrical equipment enclosures shall be NEMA 4X.
      c. For Hazardous locations all electrical equipment enclosures shall be NEMA 7 for use in Class I Division 1 areas, NEMA 9 for use in Class II, Division 1 areas and in accordance with the NEC for use in Class I Division 2, Class 2 Division 2 and Class III areas.

B. Outdoor areas that are Corrosive or Hazardous will be identified as such on the Electrical Drawings. When an outdoor area is not specifically identified as Corrosive or Hazardous it shall be considered as Wet.

C. Indoor areas that are Damp, Wet, Corrosive or Hazardous will be identified as such on the Electrical Drawings. When an indoor area is not specifically identified as Damp, Wet, Corrosive or Hazardous it shall be considered as Unclassified.

1.3 DEFINITIONS

A. Outdoor Areas:
   1. Those locations on the Project site where the equipment is normally exposed to wind, dust, rain, snow, etc.

B. Indoor Areas:
   1. Those locations on the Project site where the equipment is normally protected from wind, dust, rain, snow, etc.

C. Shop Fabricated:
   1. Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual - Stainless and Heat Resisting Steel.
   2. American National Standards Institute (ANSI):
      a. C2, National Electrical Safety Code.
   3. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      c. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. ETL Testing Laboratories, Inc (ETL).
   5. Factory Mutual System (FM):
      a. A Guide to Equipment, Materials and Services.
   6. Institute of Electrical and Electronics Engineers (IEEE):
      a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.
      b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   7. National Electrical Manufacturers Association (NEMA):
      a. ICS 6, Enclosures for Industrial Controls and Systems.
   8. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   9. Underwriters Laboratories, Inc (UL):
      a. 508, Safety Industrial Control Equipment.
      b. 698, Industrial Control Equipment for Use in Hazardous Locations.
      c. 1449, Safety Transient Voltage Surge Suppressors.
   10. Insulated Cable Engineers Association (ICEA).
   11. Illuminating Engineering Society of North America (IES).
   12. Instrumentation, System and Automation Society (ISA).

B. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, drawings and specifications, or within either document itself, the more stringent condition shall govern.

1.5 SYSTEM DESCRIPTION

A. Provide functioning systems in compliance with manufacturer's instructions, performance requirements specified or shown on the Drawings, and modifications resulting from reviewed shop drawings and field coordinated drawings.

1.6 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01300 and 01340.

2. Submit shop drawings prior to purchase or fabrication of equipment. See individual Division 16 sections for specific requirements.
3. Prior to submittals of shop drawings, coordinate electrical equipment, particularly motor control equipment, control panels, and instrumentation, with all applicable equipment and systems interfacing with that equipment.
4. Submittals shall be made in the following combinations:
   a. Conduits, busway, wireway, cable tray, ductbank details, wire and cable 600 V and below, medium voltage cable, boxes and fittings.
   b. Medium voltage switchgear, medium voltage motor starters, distribution transformers and secondary substations.
   c. Motor control centers and control equipment, low voltage switchboards, safety switches, dry-type (specialty) transformers, panelboards, power factor correction capacitors, grounding.
   d. Lamps, interior lighting, exterior building lighting, site lighting.
   e. Wiring devices.
   f. Alarm systems, communication systems and telephone systems.
5. For each product, clearly identify manufacturer by name.
6. Provide manufacturer's technical information on products to be used, including:
   a. Product descriptive bulletin.
   b. Electrical data pertinent to the Project and necessary to assure compliance with Specifications and Drawings.
   c. Equipment dimensions, where applicable.
   d. Evidence that the products submitted meet the requirements of the standards referenced.
7. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project.
8. Ensure that all submittals clearly indicate the equipment is UL or ETL listed or is constructed utilizing UL or ETL listed or UL recognized components. Where a UL standard has not been established clearly identify that no UL standard exists for that equipment.
9. For all equipment, provide manufacturer's installation instructions.

B. When a quality standard has been established by identification of a specific manufacturer or catalog number, submittals for proposed alternates and substitutions shall include:
   1. Alternate and substitute equipment cross-referenced to the equipment it is replacing.
      a. Submittal shall be marked to show how differences will be accommodated.
   2. Calculations and other detail data to allow determination of alternate and substitute equipment equivalency to the equipment it is replacing.
      a. Data supplied shall allow detailed comparison of all significant characteristics upon which the design equipment is based.
   3. Dimensioned drawings, of the same or larger scale as the Contract Drawings, for all alternate and substitute equipment that differs in size, configuration, service accessibility or in any significant way from the equipment it is replacing.
      a. Complete system layout, except that portion which is identical to the Contract Document Drawings.
      b. Redesign and modifications to all work required by the alternate or substitute equipment.

C. Operation and Maintenance Manuals:
   1. See Sections 01340.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage- either inside or on top of enclosures.

B. Protect nameplates on electrical equipment to prevent defacing.

C. Repair, restore or replace damaged, corroded and rejected items at no additional cost to the Owner.

1.8 PROJECT CONDITIONS

A. Record Drawings:
   1. The Contractor shall maintain a marked up set of Contract Document Drawings showing actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (other than #12) and all other deviations from the design drawings.
   2. All underground conduit and concealed items shall be dimensioned on the Drawings from permanent, visible, building features.
   3. Provide actual motor size, starter size, and heater size, along with all other protective equipment for all 480 V motor circuits as part of the one-line record drawings.
   4. Revise all conductor identification and circuit schedules to indicate as installed conditions.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to related Division 16 sections.
   1. All equipment of a similar type shall be by one manufacturer unless otherwise noted in the Specifications.

2.2 MATERIALS

A. Trade names and catalog numbers may be used in the Drawings or Specifications to establish quality standards and basics of design.
   1. Other listed manufacturers in the applicable specification sections with equal equipment may be acceptable.
   2. If no other manufacturer is listed, then manufacturers of equal equipment may be acceptable.

B. Listed:
   1. Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

C. Structural Steel Supports:
   1. Galvanized steel: ASTM A36.
      a. PVC coated in Class I and in corrosive areas.
   2. Stainless steel: AISI Type 316.

2.3 FABRICATION

A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.

B. Shop or Factory Finishes:
   1. See Division 11.
   2. Interiors of other painted equipment shall be either white or light gray.

PART 3 — EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with the requirements of the NEC.

B. Enclosures for Use with Electrical Equipment:
   1. NEMA 12: Use in unclassified indoor locations.
   2. NEMA 3R: Use with HVAC equipment in wet outdoor locations.
   3. NEMA 4:
      a. Use in wet indoor locations.
      b. Use in wet outdoor locations except with HVAC equipment.
   4. NEMA 4X: Use in all corrosive locations.
   5. Exceptions:
      a. As modified in other Division 16 sections.
      b. As otherwise indicated on the Drawings.
   6. Standards:
      a. NEMA ICS-6, Enclosures for Industrial Controls and Systems.
      b. UL 508, Safety Industrial Control Equipment.
      c. UL 698, Industrial Control Equipment for Use in Hazardous Locations.

C. Coordinate the installation of electrical equipment with other trades.
   1. Arrange for the building in of equipment during structure construction.
   2. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, openings, etc., as required to allow installation of equipment after structure construction is complete.

D. Verify that equipment will fit support layouts indicated.

E. Equipment Dimensions and Clearances:
   1. Do not use equipment that exceeds the indicated dimensions.
      a. Except as approved in writing by the Engineer.
   2. Electrical equipment shall be installed a reasonable distance from process, gas, air and water piping and equipment:
      a. Electrical equipment does include conduit and pull and junction boxes.
      b. Recommended minimum separation is 6 IN.
   3. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

F. Install equipment in accordance with the manufacturer's instructions.

G. Equipment Access:
   1. Install equipment so it is readily accessible for operation and maintenance.
   2. Equipment shall not be blocked or concealed.
   3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

H. Equipment shall be installed plumbed, square and true with the building construction and shall be securely fastened.

I. Outdoor wall-mounted equipment and indoor equipment mounted on earth or water bearing walls shall be provided with corrosion-resistant spacers to maintain 1/4 IN separation between the equipment and the wall.

J. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

K. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.

L. Provide all necessary anchoring devices and supports.
   1. Use supports as detailed on the Drawings and as specified.
      a. Where not detailed on the Drawings or specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.

2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.
3. Hardware shall be malleable type, corrosion resistant and shall be supported by heavily plated machine screws or brass, bronze or stainless steel bolts.
4. Do not cut, or weld to, building structural members.
5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
1. Floor-mounted equipment shall be mounted on a 4 IN high concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.

N. Material that may cause rusting or streaking on a building surface shall not be used.

O. To avoid interference with structural members and equipment of other trades, it may be necessary to adjust the intended location of electrical equipment. Unless specifically dimensioned or detailed, the Contractor may, at his discretion, make minor adjustments in equipment location without obtaining the Engineer's approval. Minor adjustments are defined as a distance not to exceed:
1. 1 FT at grade, floor and roof level in any direction in the horizontal plane.
2. 1 FT for equipment other than lighting at ceiling level in any direction in the horizontal plane.
3. 1 FT for lighting fixtures at ceiling level in any direction in the horizontal plane.
4. 1 FT on walls in a horizontal direction within the vertical plane.
5. Changes in equipment location exceeding those defined above require the Engineer's approval.
6. Particular attention shall be paid to door swings, piping, radiation, ductwork, and structural steel.
   a. In general, waste and vent lines and large pipe mains and ductwork shall be given priority for the locations and space shown.
   b. Electrical lighting fixtures shall, in general, be given priority for ceiling space.
   c. No additional compensation will be allowed for the moving of misplaced outlets, wiring, or equipment.

P. Provide tagging of electrical equipment, conduits, and conductors.
1. Each equipment shall be provided with a nameplate identifying the equipment by the tag number shown on the Drawings.
2. Each branch circuit and feeder shall be provided with a nameplate identifying, by name and tag number as shown on the Drawings, the load served.
   a. Do not abbreviate.
3. Each control device shall be provided with an escutcheon defining the device function and a nameplate identifying the controlled equipment.
4. Each enclosure larger than 12" in width shall be labeled to indicate the highest voltage contained therein.

Q. Provide electrical danger, caution, warning or safety instruction signs.

R. Field paint in accordance with Section 09905.
1. Paint all exposed conduits safety orange to match existing.
2. Paint all panels, enclosures, pull boxes, exposed outlet boxes and junction boxes safety orange to match existing, except main switchgear, main distribution switchboards, and motor control centers shall not be field painted.

S. Conduit and wire for HVAC equipment interlocks and between temperature controls and the associated HVAC equipment shall be furnished and installed with the equipment (see Division 15 of the Specifications).

T. Device Mounting Schedule:
   1. Dimensions are to center of item unless otherwise indicated.
   2. Mounting heights as indicated below unless otherwise shown on Drawings:
      a. Light switch: 48 IN.
      b. Receptacle in offices and other finished areas: 18 IN.
      c. Receptacle in all other locations: 48 IN.
      d. Telephone outlet for desk-mounted phone: 18 IN.
      e. Telephone outlet for wall-mounted phone: 60 IN.
      f. Bracket light above lavatory: 78 IN.
      g. Safety switch: 54 IN.
      h. Panelboard (to top): 72 IN.
      i. Motor starter: 54 IN.
      j. Pushbutton motor control station: 48 IN.

3.2 FIELD QUALITY CONTROL

A. Do not remove or damage fireproofing materials.
   1. Install hangers, inserts, supports, and anchors prior to installation of fireproofing.
   2. Repair or replace fireproofing removed or damaged.

B. Make all penetrations through roofs prior to installation of roofing.

C. Make all penetrations of electrical work through walls and roofs water and weather-tight.

D. Equipment furnished under this Contract for use on future work and all concealed equipment, including conduits, shall be dimensioned, on the record drawings, from visible and permanent building features.

E. After installation, all equipment shall be tested as recommended by the manufacturer.

F. Verify all components are operational.

G. Perform ground-fault performance testing as required by NEC Article 230-95(c).

H. Test Equipment Interface:
   1. Verify systems coordination and operation.

I. Set all adjustable trip protective devices as required for system protection and coordination.

J. Verify all system and equipment ground continuity.

K. Adjust installed equipment for proper operation of all electrical and mechanical components.

L. Replace equipment and systems found inoperative or defective and re-test.
   1. If equipment or system fails re-test, replace it with products that conform with Contract Documents.
   2. Continue remedial measures and re-tests until satisfactory results are obtained.
   3. Remedial measures and re-tests will be done at no cost to the Owner.

M. At Completion of Installation:
   1. Test to ensure all equipment is free of short circuits and improper grounds.
   2. Test to ensure all equipment is operational.

3.3 CLEANING

A. Clean dirt and debris from all surfaces.

B. Apply touch-up paint as required to repair scratches, etc.

C. Replace nameplates damaged during installation.

D. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

3.4 DEMONSTRATION

A. Demonstrate equipment in accordance with Division 1.

END OF SECTION

SECTION 16011

SHORT CIRCUIT, COORDINATION, AND ARC FLASH STUDIES

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SECTION 16011

SHORT CIRCUIT, COORDINATION, AND ARC FLASH STUDIES

PART 1 – GENERAL

1.1 SCOPE

A. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for a preliminary submittal of sufficient characteristics.

B. The studies shall include all portions of the electrical distribution system from the normal power sources down to and including the smallest adjustable trip circuit breaker in the distribution system.

C. The firm performing the study should be currently involved in high- and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered professional engineer. Background of the firm shall be submitted to the Engineer for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

D. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.2 DATA COLLECTION FOR THE STUDY

A. The Contractor shall provide the required data for preparation of the studies. The Engineer performing the system studies shall furnish the Contractor with a listing of the required data.

B. B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

PART 2 – PRODUCTS

2.1 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION AND COORDINATION STUDY

A. The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

B. In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

C. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend

identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

D. Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.

E. Select each primary protective device required for a wye-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.

F. Include complete fault calculations as specified herein based on contract documents.

G. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Engineer for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.

H. Contractor shall furnish all data as required by the short-circuit/coordination study vendor. Utilize data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

I. Notify the Engineer in writing of circuit protective devices not properly rated for fault conditions.

J. When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

K. The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted.

L. The report shall include the following sections:
   1. Descriptions, purpose, basis, and scope of the study
   2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same
   3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same
   4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

2.2 ARC FLASH STUDY

A. System Data:
   1. Include in the study report an electrical system single-line diagram as required by NFPA 70E, 2004 Edition, "Standard for Electrical Safety in the Workplace", as referenced in OSHA 29 CFR 1910 Subpart S, Appendix A. This information shall include nameplate data for electrical components (e.g. transformers, panelboards, switchboards, variable frequency drives, solid state reduced volting motor starters, etc.) for all portions of the electrical system from the utility intertie through the lowest rated panel.
   2. Cable sizes, types, and lengths between electrical equipment components and utility source data shall be provided for an accurate single-line representation of the electrical system. Unique characteristics of the equipment installation shall be provided which may impact the magnitude of the potential hazard (e.g. open space versus enclosure). Overcurrent device settings shall be verified.

B. System Analysis:
   1. A comprehensive analysis of the electrical system shall be performed for all equipment based on the single-line diagram provided from "Section A". This analysis shall include the following:
   2. Incident Energy Study - An incident energy study shall be done in accordance with the IEEE 1584-2004a, "IEEE Guide for Performing Arc Flash Hazard Calculations" as referenced in NFPA 70, "Standard for Electrical Safety in the Workplace", 2004 Revisions, in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.

C. Arc Flash Study Report:
   1. The supplier shall supply a comprehensive report that includes:
      a. Report summary with analysis methodology, findings, and recommendations.
      b. Summary of input data for utility source, equipment, and cables.
      c. Available fault current at each equipment location with comparison to equipment rating.
      d. Incident energy level (calories/cm^2) for each equipment location and recommended PPE.

D. Labels:
   1. Based on the results of the incident energy study, the contractor shall provide a warning label (orange ≤40 cal/cm^2) or danger label (red > 40 cal/cm^2) on each piece of equipment as specified in "Section A" in accordance with ANSI Z535.4-2002. The label shall be permanent and shall contain the following information:
      a. Arc hazard boundary (inches).
      b. Working distance (inches).
      c. Arc flash incident energy at the working distance (calories/cm^2).
      d. PPE category and description including the glove rating.
      e. Voltage rating of the equipment.
      f. Limited approach distance (inches).
      g. Restricted approach distance (inches).
      h. Prohibited approach distance (inches).
      i. Equipment/bus name.
      j. Date prepared.
      k. Supplier name and address.

PART 3 — EXECUTION

3.1 FIELD SETTINGS

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with

the approved short-circuit study, protective device evaluation study, and protective device coordination study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 16111

CONDUIT, CONDUIT FITTINGS, CONDUIT SUPPORTS

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SECTION 16111

CONDUIT, CONDUIT FITTINGS, CONDUIT SUPPORTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Conduits, conduit fittings and conduit supports, and wireway.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 09905 - *Paint.*
   3. Section 16010 - *Electrical: Basic Requirements.*
   4. Section 16115 - *Underground Conduit, Ducts, and Manholes.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C80.1, Rigid Steel Conduit - Zinc-Coated.
      b. C80.3, Electrical Metallic Tubing - Zinc-Coated.
      c. C80.6, Intermediate Metal Conduit - Zinc-Coated.
   2. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      d. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      e. A569, A569, Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
      f. A570, Hot-Rolled Sheet and Strip, Structural Quality.
      g. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      h. A635, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled.
      i. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      j. D1788, Standard Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics.
      k. D2564, Solvent Cements for (PVC) Plastic Pipe, Tubing, and Fittings.
      l. (ANSI/ASTM) F512, Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.
   3. ETL Testing Laboratories, Inc (ETL).
   4. Joint Industry Council (JIC):
      a. EGP-1, Numatics Dialog.
      b. EGP-111/EMP-1, Electrical Standards.
   5. National Electric Manufacturers Association (NEMA):
      a. RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
      b. TC-2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
      c. TC-6, PVC and ABS Plastic Utilities Duct for Underground Installation.
      d. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   6. National Fire Protection Association (NFPA):
      a. 70, National Electric Code (NEC).
   7. Underwriters Laboratories Inc (UL):
      a. 1, Flexible Metal Conduit.
      b. 6, Rigid Metal Conduit.
      c. 360, Liquid-Tight Flexible Steel Conduit.

d. 467, Grounding and Bonding Equipment.
e. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
f. 651, Schedule 40 and 80 Rigid PVC Conduit.
g. 1242, Intermediate Metal Conduit.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Sections 01340 and 16010.
2. Proposed routing of conduits buried under floor slabs-on-grade (where permitted).
a. Identify conduit by tag number of equipment served or by circuit schedule number.
3. Proposed routing and details of construction, including conduit and rebar, of conduits embedded in floor slabs, columns, etc.
a. Identify conduit by tag number of equipment served or by circuit schedule number.
4. Proposed location and details of construction for openings in slabs and walls for raceway runs.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Rigid, Non-Metallic Conduit and Fittings:
1. Shall not be stored exposed to sunlight or other UV rays.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable.

B. Submit requests for substitutions in accordance with Division 1.

2.2 RIGID GALVANIZED STEEL CONDUIT (RGS)

A. Acceptable Manufacturers:
1. Allied Tube and Conduit Corporation.
2. Triangle PWC Inc.
3. Western Tube and Conduit Corporation.
4. Wheatland Tube Company.
5. LTV Steel Company.

B. Mild steel with continuous welded seam.

C. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
1. Threads: Galvanized after cutting.

D. Internal Coating:
1. Baked lacquer, varnish or enamel for a smooth surface.

E. Standard:
1. ANSI C80.1.
2. UL 6.

2.3 PVC-COATED RIGID STEEL CONDUIT (PVC-RGS)

A. Acceptable Manufacturers:
1. Occidental Coating Company.
2. Perma-Cote.
3. Rob-Roy Ind.

B. Acceptable Manufacturers of PVC Coating Repair Kits:
   1. Occidental Coating Company.
   2. Perma-Cote.
   3. Rob-Roy Ind.
   4. Raychem "GelTek" tape.

C. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
   1. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to ANSI C80.1.
   2. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.

D. Nominal 2 mil, minimum, urethane interior coating.

E. Urethane coating on threads.

F. Conduit:
   1. Epoxy prime coated prior to application of PVC and urethane coatings.

G. Female Ends: Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is less beyond the opening.
   1. Inside diameter of the sleeve:
      a. The same as the outside diameter of the conduit to be used with it.

H. Standards:
   1. ANSI C80.1.
   2. UL 6.
   3. NEMA RN-1.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

A. Acceptable Manufacturers:
   1. Allied Tube and Conduit Corporation.
   2. LTV Steel Company.
   3. Triangle PWC Inc.
   4. Western Tube and Conduit Corporation.
   5. Wheatland Tube Company.

B. Mild steel with continuous welded seam.

C. Metallic Zinc Applied by Hot-Dip Galvanizing or Electro-Galvanizing:
   1. Threads shall be galvanized after cutting.

D. Internal Coating:
   1. Baked lacquer, varnish or enamel for a smooth surface.

E. Standard:
   1. ANSI C80.6.
   2. UL 1242.

2.5 ELECTRICAL METTALLIC TUBING (EMT)

A. Acceptable Manufacturers:
   1. Allied Tube and Conduit Corporation.
   2. LTV Steel Company.
   3. Triangle PWC Inc.
   4. Western Tube and Conduit Corporation.
   5. Wheatland Tube Company.

B. Mild steel with continuous welded seam.

C. Metallic Zinc Applied by Hot-Dip Galvanizing or Electro-Galvanizing:
1. Threads shall be galvanized after cutting.

D. Internal Coating:
1. Baked lacquer, varnish or enamel for a smooth surface.

E. Standard:
1. ANSI C80.3.
2. UL 797.

2.6 RIGID NON-METALLIC CONDUIT

A. Acceptable Manufacturers:
1. Poly-vinyl chloride (PVC) conduit:
2. Carlon.
3. Certainteed Corporation.
4. Western Plastics Corporation.
5. Acrylonitrile-butadiene-styrene (ABS) conduit:
   a. Carlon.
   b. Certainteed Corporation.
   c. Canadian General Electric Company.
   d. Western Plastics Corporation.

B. Schedules 40 and 80:
1. Polyvinyl-chloride (PVC) plastic compound which meets, as a minimum, ASTM D1784 cell classification PVC 12233-A, B, or C.
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:
   a. ASTM D1784.
   b. NEMA TC-2.
   c. UL 651.

2.7 PVC-COATED FLEXIBLE GALVANIZED STEEL (LIQUID-TIGHT) CONDUIT (FLEX-LT)

A. Acceptable Manufacturers:
1. Anamet, Inc.
2. Electri-Flex Company.
3. International Metal Hose Company.

B. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.

C. Extruded PVC outer jacket positively locked to the steel core.

D. Liquid and vaportight.

E. Standard:
1. UL 360.

2.8 WIREWAY

A. Acceptable Manufacturers:
1. Crouse-Hinds.
2. E.M.Wiegmann and Company, Inc.
3. Hoffman Engineering Company.

B. Enclosure:
   1. Minimum wall thickness of 0.040 IN.

C. Furnished without knockouts.

D. Designed for continuous grounding.

E. Suitable for lay-in conductors.

F. Not smaller than 4 by 4 IN unless otherwise indicated on the Contract Drawings.

G. Covers:
   1. When passing through partitions:
      a. Solid and non-removable.
   2. Accessible: Solid, hinged, with captive screw fasteners.

H. General Purpose (NEMA 1) Wireway:
   1. Steel, finished with rust inhibiting phosphatizing coating and gray baked enamel finish on interior and exterior surfaces.
   2. Standards:
      a. UL 870.
      b. NEMA 250.

I. Dusttight (NEMA 12) Wireway:
   1. Steel, finished with rust inhibiting phosphatizing coating and gray baked enamel finish on interior and exterior surfaces.
   2. Cover: Fully gasketed and provided with captive clamp type latches.
   3. Standards:
      a. JIC EGP-1.
      b. JIC EMP-1.
      c. NEMA 250.
      d. UL 870.

J. Watertight (NEMA 4) Wireway:
   1. Enclosure: Type 304 stainless steel.
   2. Cover: Fully gasketed and provided with captive external screw type clamps.
   3. Standards:
      a. JIC EGP-111/EMP-1.
      b. UL 870.

2.9 CONDUIT FITTINGS AND ACCESSORIES

A. Acceptable Manufacturers:
   1. Adalet.
   2. Appleton.
   3. Carlon.
   4. Certainteed.
   5. Crouse-Hinds.
   6. Killark.
   7. Occidental Coating Company.
   8. OZ Gedney Company.
   9. Perma-Cote.
   10. RACO.
   11. Rob-Roy Ind.
   12. Steel City.
   13. Thomas and Betts.
   14. Western Plastics Company.

B. Smoke and Fire Stop Fittings:
   1. 3 HR UL rating.
   2. Flanged and segmented.
   3. Cast malleable iron mounting frame and pressure plate.
      a. Elastomeric sealing material.
      b. Steel clamping hardware.

C. Fittings for Use with RGS and IMC in Non-Hazardous Locations:
   1. Expansion couplings:
      a. 2 IN nominal straight-line conduit movement in either direction.
      b. Weathertight.
      c. Insulating bushing.
      d. Sleeve-steel, zinc plated.
   2. 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. Watertight.
      d. Insulating bushing.
      e. End couplings/hubs - bronze; or steel zinc-plated with aluminum cellulose lacquer finish.
      f. Outer jacket-neoprene.
      g. Jacket clamps-stainless steel.
      h. Inner sleeve (when used) - molded plastic.
   3. Pulling elbows and tees:
      a. Raintight.
      b. Cover - steel, zinc-plated.
   4. Mogul pulling elbows:
      a. Die cast copper free aluminum.
   5. Couplings for threadless RGS and IMC:
      a. Concrete-tight.
      b. Gland compression type or self-threading type.
         1) Self-threading type: Steel, zinc-plated with case hardened steel forming threads.

D. Fittings for Use with RGS and IMC in Non-Hazardous and Non-Corrosive Locations:
   1. Materials: The following are minimum requirements unless otherwise noted.
      a. Body: Malleable iron, zinc- or cadmium-plated; steel, hot-dipped galvanized; or steel zinc plated with aluminum lacquer or aluminum enamel finish.
      b. Covers: Malleable iron, zinc plated.
      c. Gaskets: Neoprene or PVC, integrally fused to or recessed into the body.
      d. Insulators-phenolic, thermosetting:
         1) Minimum 105 DegC UL rating.
      e. Grounding saddles tin-plated copper or bronze suitable for use with copper and aluminum conductors.
      f. Bonding jumpers: Tinned copper flexible braid.
      g. Locknuts: Malleable iron, zinc plated.
   2. All fittings: Threaded unless otherwise noted.
   3. All covers: Gasketed.
   4. Standards:
      a. UL 6.
      b. UL 467.
      c. UL 514.
      d. UL 1242.
   5. Hubs shall be raintight.
   6. Straight couplings: Same material and finish as the conduit with which they are used.
   7. Expansion couplings:
      a. 2 IN nominal straight-line conduit movement in either direction.
      b. Weathertight.
      c. Insulating bushing.

d. Sleeve-steel, zinc plated.
8. 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. Watertight.
d. Insulating bushing.
e. End couplings/hubs - bronze; or steel zinc-plated with aluminum cellulose lacquer finish.
f. Outer jacket-neoprene.
g. Jacket clamps-stainless steel.
h. Inner sleeve (when used) - molded plastic.

E. Fittings for Use with PVC-RGS:
1. In corrosive locations and direct buried:
a. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS and IMC in Non-Hazardous and Non-Corrosive Locations"; and coated as defined under paragraph "PVC-RGS."

F. Fittings for use with EMT:
1. Minimum requirements unless noted:
a. Bodies: zinc plated steel.
b. Lock nuts and compression nuts: malleable iron or steel, zinc plated.
c. Insulators: phenolic, thermosetting, minimum 105 deg. C UL rating.
2. All fittings to be compression type, set screw type not permitted.
3. Standard: UL 514.
4. Elbows and offsets:
a. Malleable iron, zinc plated.
5. Insulated bushings:
a. Malleable iron, zinc plated or steel, hot dipped galvanized.

G. Fittings for Use with Rigid Non-Metallic Conduit:
1. Fittings shall be of the same material, thickness, and construction as the conduits with which they are used.
a. Standards:
1) UL 651.
2) NEMA TC-2-1978.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
a. Shall not be more than 1 year past date of manufacture.
b. Standard: ASTM D2564.

H. Fittings for Use with FLEX-LT:
1. Fittings shall meet the following minimum requirements unless otherwise noted:
a. Body: Malleable iron, zinc-plated.
b. Ferrule: Steel, zinc-plated.
c. Locknuts and compression nuts: Malleable iron, zinc-plated.
d. Sealing ring: Neoprene.
2. Standard: UL 514.

2.10 CONDUIT SUPPORT SYSTEMS

A. For Use with RGS , IMC, EMT:
1. Acceptable manufacturers:
a. Unistrut Building Systems.
b. B-Line Systems Inc.
c. Kindorf.
2. All components shall be hot-dipped galvanized.
a. Standard: ASTM A153.
3. Channels and brackets:

a. Formed from hot rolled carbon steel sheet and strip.
b. Standard: ASTM A570.

4. Fittings:
   a. Formed from structural steel or hot-rolled carbon steel sheet and strip.
   b. Standards:
      1) ASTM A36 and A635.
5. Clamps:
   a. Formed from low carbon hot rolled steel sheet and strip.
   b. Standard: ASTM A569.
6. Channel nuts:
   a. Formed from mild steel bar stock, case hardened.
   b. Standard: ASTM A575.
7. Screws, nuts, bolts and continuous threaded rods.
   a. Formed from mild steel bar stock.
   b. Standards:
      1) ASTM A307 and A563.

B. For Use with PVC-RGS:

1. All components: Comply with the requirements of paragraph "For Use with RGS" and with the coating requirements of paragraph "PVC-RGS"; except screws, nuts and bolts shall be stainless steel.
   a. Stainless steel channels, brackets, fittings, clamps, channel nuts and continuous threaded rod may be used in lieu of PVC coating these components.

2.11 SLEEVES THROUGH WALLS AND FLOORS

A. Uncoated or Galvanized Iron or Steel:

1. Wall thickness: Not less than standard Schedule 40 pipe.

2.12 ALL CONDUIT FITTINGS AND WIREWAY

A. Mark Products:

1. UL or ETL listed.
2. Identify the nominal trade size on the product.
3. Stamp with the name or trademark of the manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Shall be in accordance with the requirements of NFPA 70.

B. Conduits shall be routed in the field unless otherwise indicated.

1. Whenever possible avoid routing conduits through areas of high ambient temperature or radiant heat.

C. Size of Raceways and Conduits:

1. Raceway sizes are normally shown on the Drawings. If a size is not shown on the Drawings, or if a minimum size is not stated in the Specifications, then size in accordance with the NEC.
2. Conduits shall not be smaller than 3/4 IN trade size, unless otherwise shown on the Drawings.

D. Provide all required openings in walls, floors, and ceilings for conduit penetration.

E. Conduit Runs:

1. All conduits within a structure shall be installed exposed except as follows:
   a. Above suspended ceilings.
   b. Within stud, masonry and concrete walls of finished areas.

c. With the Engineer's permission, or where shown on the Contract Drawings, may be embedded in floor slabs and columns or buried under floor slabs.

1. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.

F. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.

G. Total of Bends in a Conduit Run:

1. Less than 360 degrees.
2. Provide pull boxes, conduits, or pulling elbows or tees as needed.

H. Raceway runs, where shown, indicate the preferred location. Site conditions may affect actual routing. Coordinate routing and measurement with other trades and with equipment suppliers to avoid interference with equipment, piping, ductwork, etc.

TABLE 1. UNCLASSIFIED AREAS

TYPE	EXPOSED	IN WALLS OF FINISHED AREA	UNDER FLOOR SLAB
Rigid	RGS	RGS	PVC-40
	IMC	IMC	
	EMT*	EMT*	
	* as noted on drawings	* as noted on drawings	
Flexible	FLEX-LT	None	None

TABLE 2. CLASSIFIED AREAS

TYPE	EXPOSED DAMP	EXPOSED WET	EXPOSED CORROSIVE	ALL CLASS 1 CORROSIVE	ALL CLASS 1 NON-CORROSIVE	UNDER FLOOR SLAB
Rigid	RGS IMC	RGS IMC	PVC-RGS	PVC-RGS	RGS	PVC-40
Flexible	FLEX-LT	FLEX-LT	FLEX-LT	HAZ-LOC	HAZ-LOC	None
				FLEX	FLEX	
				COUPL.	COUPL.	

TABLE 3. EXTERIOR - BURIED - RIGID ONLY

CONCRETE ENCASED POWER, CONTROL AND INSTRUMENTATION	DIRECT BURIED POWER, CONTROL AND INSTRUMENTATION
PVC-40	PVC-80

I. FLEX-LT:

1. Install as the final conduit to motors, electrically operated valves, primary elements (instrumentation), and electrical equipment that is liable to vibrate.
2. Shall not be used as a conduit run:
   a. Maximum length shall not exceed:
      1) 36 IN to motors.
      2) 24 IN to all other equipment.

J. Wireways:

1. May be installed:
   a. Where indicated in the Contract Drawings: Installed exposed.

K. Conduit Seals:

1. Installed:
   a. In hazardous areas as required by NEC.
   b. In each conduit in a corrosive area entering or leaving that area and entering or leaving an electrical equipment enclosure in that area.
   c. So that the filler plug and drain are accessible.

d. Complete with sealing fiber and compound.

L. Conduit Support Systems:
1. Compatible with the material and finish of the conduit supported.
a. Hot-dipped galvanized steel for use with RGS and IMC.
b. PVC coated hot-dipped galvanized steel for use with PVC-RGS in corrosive areas.
c. PVC-coated hot-dipped galvanized steel for use with PVC rigid non-metallic conduit.

M. 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.

N. Conduit Installation:
1. Install conduit and fittings, as required (including offsets and crossovers), for a complete system that has a neat appearance and is in compliance with all applicable codes.
2. Accessible conduit and wireway:
a. Run in straight lines parallel to or at right angles to building lines.
1) Install conduit adjacent to walls and floors.
2) Maintain minimum 6 IN separation between instrumentation and power conduits.
b. Maintain minimum 6 IN separation from process, gas, air and water pipes.
3. Conduit support systems:
a. Support conduit from the building structure.
1) Do not support conduit from process, gas, air or water piping; or from other conduits.
b. 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.
1) Do not exceed maximum concentrated load recommended by the manufacturer on any support.
2) Conduit hangers: Continuous threaded rods combined with struts or conduit clamps:
a) Do not use perforated strap hangers and iron bailing wire.
3) Do not use suspended ceiling support systems to support raceways.
4) Hangers in metal roof decks:
a) Utilize fender washers.
b) Not extend above top of ribs.
c) Not interfere with vapor barrier, insulation, or roofing.
c. Conduit support system fasteners:
1) Use sleeve-type expansion anchors as fasteners in masonry wall construction. Do not use concrete nails and powder-driven fasteners.
d. Maximum spacing between conduit supports:
1) Per NEC requirements.
1) Support all conduits within 3 FT of the conduit termination.
e. Support all conduits at 90-degree bends and at vertical drops.
f. Provide substantial vertical support for all conduit drops for stability and to minimize vibration.
g. Where sufficient room exists within the housing, conduit to roof-mounted equipment shall be stubbed up inside the housing.
4. Conduit embedded in columns and floor slabs or buried under slab-on-grade:
a. Run in the most direct, practical route.
b. Not to be installed under equipment pads.
c. No crossovers.
d. Secured in place to prevent movement during the backfill and pour.
e. Maintain minimum 6 IN separation between instrumentation and power conduits.

f. Maintain minimum 6 IN separation from process, gas, air and water pipes.

5. Conduits and accessories embedded in concrete where shown on the Contract Drawings:
   a. Shall not be considered to replace structurally the displaced concrete except as indicated in the following:
      1) Conduit and fittings shall not displace more than 4 percent of the area of the cross-section of a column on which stress is calculated or which is required for fire protection.
      2) Size and locate sleeves or conduits passing through floors, walls, or beams so as not to significantly impair the strength of the construction.
      3) Sleeves or conduits passing through floors, walls or beams may be considered as replacing the displaced concrete structurally in compression.
         a) Shall not be exposed to rusting or other deterioration.
         b) Nominal inside diameter shall not exceed 2 IN.
         c) Minimum spacing: 3 DIA OC.
   b. Shall not be larger in outside diameter than one-third the thickness of the slab, column or beam.
   c. Minimum spacing: 3 DIA OC.
   d. Reinforced concrete construction:
      1) Conduit not run in beams.
      2) Place conduit after reinforcing steel has been laid and the reinforcement steel shall not be displaced.
      3) Provide a minimum of 1-1/2 IN of cover over conduit, excluding surface finish.
      4) Locate on the span center line conduits that do not run parallel with the principal reinforcing steel.
6. Conduit above suspended ceilings:
   a. Run in the most direct, practical route, without crossovers.
7. Underground conduit:
   a. See Section 16115.
8. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
9. Threaded connections shall be made wrench-tight.
10. Conduit joints shall be watertight.
    a. Where exposed to possible submersion.
    b. In areas classified as wet.
    c. Underground.
11. Conduits shall be installed to eliminate moisture pockets. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run. Provide drain fitting in conduits entering equipment enclosures from top or sides.
12. Rigid non-metallic conduit and fittings shall be joined utilizing solvent cement.
    a. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
13. Install expansion fittings:
    a. Where conduits span structural expansions joints.
    b. In long conduit runs.
    c. Elsewhere as identified on the Drawings.
       1) Provide fittings with 2 IN straight-line movement in either direction.
          a) Except where identified on the Drawings as requiring 4 IN straight-line movement in either direction.
14. Install expansion/deflection fittings:
    a. Where conduits enter a structure.
       1) Except electrical manholes and handholes.
       2) Except where the ductbank is tied to the structure with rebar.
    b. Elsewhere as identified on the Drawings.
    c. Provide fittings with 3/4 IN straight line movement in either direction and 30 degree deflection.
       1) Except where identified on the Drawings as requiring 2 IN straight line movement in either direction.
15. Provide conduit seals:
    a. Not more than 18 IN from where they are required.

16. Terminate conduits:
    a. In NEMA 1 and 12 type enclosures:
        1) With an insulated grounding bushing on the interior.
        2) With a locknut on the exterior.
    b. In NEMA 3R, 4, 4X and 7/9 type enclosures:
        1) Into a threaded hub.
        2) With an insulating bushing, unless the hub provides equivalent protection to the conductors.
    c. When stubbed up through the floor:
        1) With an insulated grounding bushing.
17. Threadless couplings shall only be used to join new RGS to existing RGS conduit or new IMC to existing IMC 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.

O. The protective coating integrity of conduits, fittings, and accessories shall be maintained.
    1. Repair RGS, IMC and EMT utilizing a zinc rich paint.
    2. Repair PVC-RGS 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. The total nominal thickness: 40 mil.
    3. Repair surfaces that will be inaccessible after installation prior to installation.

P. 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.

Q. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

R. Fill openings in walls, floors, and ceilings and finish flush with surface.

S. Painting:
    1. Paint all exposed conduits in compliance with Section 09905, and Section 16010.

END OF SECTION

SECTION 16115

UNDERGROUND CONDUIT AND DUCTS

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SECTION 16115

UNDERGROUND CONDUIT AND DUCTS

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Underground power, control, and instrumentation conduits and ductbanks.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Division 2 - Site Construction.
   3. Division 3 - Concrete.
   4. Section 16010 - *Electrical: Basic Requirements.*
   5. Section 16111 - *Conduit, Conduit Fittings, Conduit Supports.*
   6. Section 16120 - *Wire and Cable - 600 Volt and Below.*
   7. Section 16450 - *Grounding.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing Materials (ASTM):
      a. A536, Standard Specification for Ductile Iron Castings.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC), Latest Edition.
   3. American Association of State Highway and Transportation Officials (AASHTO).

B. Miscellaneous:
   1. Drawings indicate the intended location of ductbanks and direct buried conduit. Field conditions may affect actual routing.

1.3 DEFINITIONS

A. Direct-buried conduit means individual (single) underground conduits without concrete encasement.

B. Direct-buried ductbank means multiple underground conduits, in a common trench, without concrete encasement.

C. Concrete encased ductbank means any underground conduit or combination of underground conduits encased in a common concrete envelope.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 and 16010 - *Electrical: Basic Requirements.*
   2. Fabrication and layout drawings:
      a. Provide cross-sectioned sketch of each ductbank.
         1) Dimension spacing between conduits.
         2) Dimension concrete envelope and reinforcing, where applicable.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Precast manholes:
   a. Oldcastle Precast, Inc.
   b. Utility Vault Co.
   c. Or approved equal.
2. Manhole covers:
   a. Neenah.
   b. Utility Vault Co.
   c. Or approved equal.
3. Prefabricated Composite Handholes:
   a. Quazite Strongwell.
   b. Amorcast Products Company.
   c. Synertech.
   d. Or approved equal.
4. Cable racks:
   a. Unistrut.
   b. B-Line.
   c. Condux International, Inc.
   d. Underground Devices, Inc.
   e. Or approved equal.
5. Cable pulling irons:
   a. Condux International, Inc.
   b. Or approved equal.
6. Ground rods and grounding equipment:
   a. See Section 16450.
7. Ground wire:
   a. See Section 16120.
   b. Carlon.
   c. Or approved equal.
8. Duct terminators:
   a. Condux International, Inc.
   b. Or approved equal.
9. Conduit:
   a. See Section 16111.
10. Duct spacers:
   a. Underground Devices, Inc.
   b. Condux International, Inc.
   c. Carlon.
   d. Or approved equal.
11. Warning Tape:
   a. W. H. Brady Company.
   b. Seton Nameplate Company.
   c. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 MATERIALS, DESIGN AND FABRICATION

A. Ground Rods and Grounding Equipment:
   1. See Section 16450 - *Grounding*.

B. Ground Wire:
   1. See Section 16120 - Wire and Cable - 600 Volt and Below.

C. Conduit:
   1. See Section 16111- Conduit, Conduit Fittings, Conduit Supports.

D. Duct Spacers:
   1. High density polyethylene or high impact polystyrene.
   2. Interlocking.

3. Provide 2 IN minimum spacing between conduits.

E. Warning Tape:
1. Approved manufacturers and catalog numbers:
a. W H Brady Company, Catalog S-10, #91296.
2. Material: Polyethylene.
3. Thickness: 3.5 mils.
4. Tensile strength: 1750 psi.
5. Size: 6 IN wide (minimum).
6. Legend: Preprinted and permanently imbedded:
a. Message continuously printed.

F. Precast Manholes:
1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures.
2. Shall have an AASHTO live load rating of H-20.
3. Mating edges shall be tongue and groove type.

G. Manhole Cover and Frame:
1. Cast ductile iron: ASTM A536.
2. AASHTO live load rating: H-20.
3. Diameter: 24 IN.
4. Cast the legend "ELECTRICAL" into manhole and handhole covers.

H. Prefabricated Composite Material Handholes:
1. Fiberglass reinforced polymer concrete.
2. Minimum load ratings:
a. Design load: 8000
b. Test load: 12000
3. Open bottom, 6" gravel underdrain.
4. Stackable design as required for specified depth.
5. Cover:
a. Engraved legend of "ELECTRIC" or other to suit application.
b. Non-gasketed bolt down with stainless steel penta head bolts.
c. One or multiple sections so the maximum weight of a section is 125 LBS.
6. Cover lifting hook: 24 IN. minimum in length.
7. Nominal 17" x 30" x 12".

I. Cable Racks and Hooks:
1. 3/16 IN hot-dipped galvanized steel (nylon or PVC coated).
2. 120 LBS minimum loading capacity.
3. Minimum 7-1/2 IN long hooks with three-point locking to resist twisting.

J. Cable Pulling Irons:
1. 7/8 IN DIA hot-dipped galvanized steel.
2. 6000 LB minimum pulling load.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
1. Install products in accordance with manufacturer's instructions.
2. Comply with Division 2 for trenching, backfilling and compacting.
3. Drawings indicate the intended location of manholes and handholes; and routing of precast cable trench, ductbanks and direct buried conduit. Field conditions may affect actual routing.
4. Manhole and Handhole Locations:
a. Approximately where shown on the Drawings.

b. As required for pulling distances.
c. As required to keep pulling tensions under allowable cable tensions.
d. As required for number of bends in ductbank routing.
e. Shall not be installed in a swale or ditch.
f. Determine the exact locations after consideration has been given to the location of other utilities, grading, and paving.
g. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.
h. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

B. Underground Conduits:
1. Direct-buried ductbank:
a. Provide electrical duct system consisting of conduits directly buried in earth.
1) Lay conduits on minimum 2 IN sand base.
b. For circuits 600 V and below, install so that the top of the uppermost conduit, at any point, is not less than the minimum depths established by the NEC (Table 300.5 and exceptions).
1) RGS conduit: 6 IN.
2) Rigid PVC conduit: 18 IN.
3) Under areas subject to vehicular traffic:
a) All applications: 24 IN.
4) Unless a greater depth is detailed on the Drawings.
2. Direct-buried conduit:
a. Provide electrical duct system consisting of conduits directly buried in earth.
b. For circuits 600 V and below, install so that top of conduit, at any point, is not less than the minimum depths established by the NEC (Table 300.5 and exceptions).
1) RGS conduit: 6 IN.
2) Rigid PVC conduit: 18 IN.
3) Under areas subject to vehicular traffic:
a) All applications: 24 IN.
4) Unless a greater depth is detailed on the Drawings.
3. Concrete encased ductbank:
a. Ductbank system consists of conduits completely encased in minimum 2 IN of concrete and with separations between different cabling types as required in Section 16111 or as detailed on the Drawings.
b. Install so that top of concrete encased duct, at any point:
1) Is not less than 24 IN below grade.
2) Is below pavement sub-grading.
c. Under traffic areas (roadways, parking lots, etc.) and for a distance 10 FT either side of the traffic area, and elsewhere as defined on the Drawings, the concrete shall be reinforced. The reinforcement shall consist of #4 bars and #4 ties placed 12 IN on center as detailed on the Drawings.
d. Conduit supports shall provide a uniform minimum clearance of 2 IN between the bottom of the trench and the bottom row of conduit.
e. Conduit separators shall provide a uniform minimum clearance of 2 IN between conduits or as required in Section 16111 for different cabling types.
4. Underground conduits and ductbanks shall comply with the following:
a. Minimum grade shall be 4 IN per 100 FT or as detailed on the Drawings.
1) Low point shall be at one end of the conduit run.
b. During construction and after conduit installation is complete; plug the ends of all conduits.
c. Provide conduit supports and separators of concrete, plastic, or other suitable nonmetallic, nondecaying material designed for that purpose.
1) Concrete encasement supports shall provide a uniform minimum clearance of 2 IN between the bottom of the trench and the bottom row of conduit.
2) Separators shall provide a uniform minimum clearance of 2 IN between conduits.

3) Place supports and separators for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
   a) 1 IN and less: 3 FT.
   b) 1-1/4 to 3 IN: 5 FT.
   c) 3-1/2 to 6 IN: 7 FT.
4) Place supports and separators for rigid steel conduit on maximum centers as indicated for the following trade sizes:
   a) 1 IN and less: 10 FT.
   b) 1-1/4 to 2-1/2 IN: 14 FT.
   c) 3 IN and larger: 20 FT.
5) Securely anchor conduits to supports and separators to prevent movement during placement of concrete or soil.
6) Do not place concrete or soil until the Engineer has observed conduits.

d. Stagger conduit joints at intervals of 6 IN vertically.
e. Make conduit joints watertight and in accordance with manufacturer's recommendations.
   1) Make plastic conduit joints by uniformly brushing a plastic solvent cement on inside of plastic coupling fitting and outside of conduit ends. Slip conduit and fitting together with a quick one-quarter turn twist to set joint tightly.
f. Accomplish changes in direction of runs exceeding a total of 5 degrees by long sweep bends having a minimum radius of 25 FT.
   1) Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
g. Furnish manufactured bends at end of runs.
   1) Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.
h. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
i. After the conduit run has been completed, pull a standard flexible mandrel having a length of not less than 12 IN and a diameter approximately 1/4 IN less than the inside diameter of the conduit through each conduit. Then pull a brush with stiff bristles through each conduit to remove any foreign material left in conduit.
j. Pneumatic rodding may be used to draw in lead wire.
   1) Install a heavy nylon cord free of kinks and splices in all unused new ducts.
   2) Extend cord 3 FT beyond ends of conduit.
k. Transition from PVC to RGS conduit a minimum of 5 FT prior to entering a structure or going above ground.
   1) Unless otherwise indicated on the Drawings.
   2) PVC conduit may be extended directly to pull, junction and transformer boxes, manholes and handholes.
l. Where conduits enter pull, junction and transformer boxes; manholes and handholes:
   1) Terminate rigid PVC conduits in end bells.
   2) Terminate steel conduits in insulated bushings.

C. Warning Tape:
1. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable.
   a. 6 IN below finished grade where conduit or ductbank is 12 IN or more below finished grade.
   b. 3 IN below finished grade where conduit or ductbank is less than 12 IN below finished grade.
2. Provide warning tape as follows:
   a. Electrical ductbanks or directly buried conduit:
      1) Legend: CAUTION CAUTION CAUTION (1st line), BURIED ELECTRIC LINE (2nd line).
      2) Letters: 1-1/4 IN minimum.
      3) Interval: Continuous.
      4) Color: Red and black letters.

D. Precast Manholes:

1. For use in non-vehicular traffic areas.
2. Construction:
   a. Grout or seal all joints, per manufacturers instructions.
   b. Covers and frames: Paint with two coats asphalt paint before setting.
   c. Support cables on walls by cable racks:
      1) Provide a minimum of two racks, install symmetrically on each wall of manholes. Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
      2) Equip cable racks with adjustable hooks: Minimum of two cable hooks per rack or as required by the number of conductors to be supported with one spare hook on each rack.
   d. Install a cable-pulling iron in each wall opposite each ductbank entrance.
   e. In each manhole, drive ¾ IN x 10 FT long copper clad ground rod into the earth with approximately 6 IN exposed above finished floor.
      1) Drill opening in floor for ground rod.
      2) Connect all metallic conduits, racks, and other metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.
3. Place manhole on a foundation of compacted ¼ to ½ IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than manholes footprint on all sides.
4. Install so that the top of cover is 1 IN above finished grade. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of manhole frame to temporarily elevate manhole cover to existing grade level.
5. After installation is complete, backfill and compact soil around manholes.
6. Manhole size:
   a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
   b. Minimum floor dimension of 5 FT x 5 FT and a minimum depth of 6 FT.

END OF SECTION

SECTION 16120

WIRE AND CABLE - 600 VOLT AND BELOW

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SECTION 16120

WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building wire and cable (600 V and below), instrumentation cable, splices, taps, electrical tape and pulling lubricant.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):
      a. S-66-524/WC 7, Cross-Linked Thermosetting- Polyethylene-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
      b. S-68-516/WC 8, Ethylene-Propylene Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
      c. S-61-402/WC 5, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc (UL):
      a. 44, Rubber Insulated Wires and Cables.
      b. 486A, Wire Connectors and Soldering Lugs for use with Copper Conductors.
      c. 486B, Wire Connectors for use with Aluminum Conductors.
      d. 510, Insulating Tape.
      e. 1449, Safety Transient Voltage Surge Suppressors.
      f. 83, Thermoplastic-Insulated Wires and Cables.

1.3 DEFINITIONS

A. Cable: Multi-conductor, insulated, with outer sheath.
   1. May contain either building wire or instrumentation wire.

B. Instrumentation Cable: Multiple conductors, insulated, twisted with outer sheath, intended for transmission and distribution of low current (4-20 mA DC) or low voltage (0-10 V DC) analog signals, No. 16 AWG and smaller. Commonly used types are defined in the following:
   1. TP: Twisted pair without shield.
   2. TSP: Twisted-shielded pair.
   3. TST: Twisted-shielded triad.

C. Power Cable: Containing multi-conductor insulated building wire, No. 12 AWG and larger.

D. Control Cable: Containing multi-conductor insulated control wires, No. 16, No. 14 or No. 12 AWG.

E. Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals and 16010 - Electrical: General Requirements.*

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Building wire, power and control cable:
   1. All conductors shall be copper.
   2. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
      a. American Insulated Wire Corporation.
      b. Cablec Corporation.
      c. Carol Cable Company, Inc.
      d. Rome Cable Corporation.
      e. Southwire Company.
      f. Or approved equal.
   3. Conform to ICEA/NEMA S-66-524/WC 7 and UL 44 for type XHHW-2 insulation.
   4. Conform to ICEA/NEMA S-61-402/WC 5 and UL 83 for type THHN/THWN-2 insulation.

B. Instrumentation Cable:
   1. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
      a. Alpha Wire Corporation.
      b. American Insulated Wire Corporation.
      c. Belden Wire and Cable.
      d. Carol Cable Company.
      e. Or approved equal.
   2. Conform to UL 2092, Communications Cable, NEC type CM, thinned copper conductors, 100 percent shield coverage, polyethylene insulated with PVC jacket.
   3. 300 volt, 60 DegC rating.

C. Building wire, power cable, control cable and instrumentation cable:
   1. UL listed or UL recognized.
   2. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.

D. Splices and Taps:
   1. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
      a. Burndy Corporation.
      b. Ideal.
      c. Minnesota Mining and Manufacturing Co.
      d. Penn Union.
      e. Thomas and Betts.
      f. Or approved equal.
   2. UL listed.
   3. Conform to UL 486A.

E. Electrical Tape:
   1. Pressure sensitive vinyl.
   2. Premium grade.
   3. Heat, cold, moisture, and sunlight resistant.
   4. UL listed.

5. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
6. For cold weather or outdoor location, tape must also be all-weather.
7. Comply with UL 510.

F. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

G. Submit requests for substitutions in accordance with Division 1.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Usage of Insulation Types:
1. Type XHHW-2 shall be used for feeders, for branch circuits No. 6 AWG and larger.
2. Type THHN/THWN-2 shall be used for branch circuits No. 8 AWG and smaller, and single conductor control circuits.

B. Conductor size limitations:
1. 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.

C. Color code all wiring as follows:
1. Lighting and power wiring:

	120/208 V	480 V
Phase 1	Black	Brown
Phase 2	Red	Orange
Phase 3	Blue	Yellow
Neutrals	White	White
Ground	Green	Green

2. Color code ends of feeder phase conductors only.

D. Install all wiring in raceway unless otherwise indicated on the drawings.

E. Feeder, branch, control and instrumentation circuits shall not be combined in conduit, wireway, junction or pull boxes; except as permitted in the following:
1. Where specifically indicated on the drawings or field conditions dictate and written permission is obtained from the Engineer.
   a. Feeder and branch circuits shall be isolated from each other and from all control and instrumentation circuits.
   b. Control circuits shall be isolated from feeder, branch and instrumentation circuits.
      1) Where combining of control circuits is permitted the combinations shall comply with the following:
         a) 12 VDC, 24 VDC and 48 VDC may utilize a common raceway.
      2) 125 VDC shall be isolated from all other AC and DC circuits.
      3) AC control circuits shall be isolated from all DC circuits.
   c. Instrumentation circuits shall be isolated from feeder, branch and control circuits.
      1) Certain instrumentation equipment are "two-wire" devices which accept a 24 VDC input and produce a 4-20 mA DC output. This wiring shall be in a common raceway.
      2) Where combining of instrumentation circuits is permitted the combinations shall comply with the following:
         a) 4-20 mA DC and 0-10 VDC analog signal circuits may utilize a common raceway.

2. For lighting circuits, multiple branch circuits may be installed in a raceway as allowed by the NEC, with the wire ampacity derated in accordance with the requirements of the NEC. Raceway fill shall not exceed the limits established by the NEC.

F. Ground the drain wire of shielded cables at one end only.
   1. The preferred grounding location is at the load, not at the source.

G. Maintain electrical continuity of the shield when splicing twisted shielded conductors.

H. Make splices and taps only at pull or junction boxes.
   1. Crimp or indenter-type connectors: Installation shall be made using a ratchet type compression tool.
   2. Insulated conical spring type connectors may be used for wire smaller than #6 AWG.
   3. Solderless lugs and screw type connectors may be used for #6 AWG and larger wire.

I. Electrical Tape Usage:
   1. For insulating connections of #8 AWG wire and smaller: 7 mil vinyl tape.
   2. For insulating splices and taps of #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. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
   1. Contractor shall supply terminal boards as required.
   2. Do not field wire directly to devices.
   3. Ground both ends of spare wires.

END OF SECTION

SECTION 16130

OUTLET, PULL, AND JUNCTION BOXES

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SECTION 16130

OUTLET, PULL, AND JUNCTION BOXES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Outlet, pull and junction boxes.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 09905 - *Painting.*
   3. Section 16010 - *Electrical: Basic Requirements.*
   4. Section 16111 - *Conduit, Conduit Fittings, Conduit Supports, and Wireway.*
   5. Section 16140 - *Wiring Devices.*
   6. Section 16450 - *Grounding.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16010 - *Electrical: Basic Requirements.*

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Section 16010 - *Electrical: Basic Requirements.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Galvanized steel boxes:
      a. Appleton Electric Co.
      b. Steel City.
      c. Raco.
      d. Or approved equal.
   2. Sheet metal boxes for non-classified areas:
      a. Hoffman Engineering Co.
      b. Or approved equal.
   3. Corrosion-resistant boxes:
      a. Hoffman Engineering Co.
      b. Crouse-Hinds.
      c. Or approved equal.
   4. Hazardous location boxes (Class I, II, & III):
      a. Appleton Electric Co.
      b. Crouse-Hinds.
      c. Killark.
      d. O-Z/Gedney.
      e. Or approved equal.

5. Raintight and watertight boxes:
   a. Appleton Electric Co.
   b. Crouse-Hinds.
   c. Or approved equal.
6. Terminal boxes:
   a. Hoffman Engineering Co.
   b. Or approved equal.
7. Boxes in earth:
   a. Carlon Electric Products.
   b. Or approved equal.
8. Exposed switch and receptacle boxes:
   a. Appleton Electric Co.
   b. Crouse-Hinds.
   c. Killark.
   d. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 MATERIALS

A. Pull and Junction Boxes for Offices and Other Dry Architecturally Finished Areas:
1. Material: 14 GA, galvanized steel.
2. Concentric knockouts on all four sides.
3. Flat cover fastened with screws.
4. NEMA 1 classification.
5. UL listed.

B. Pull and Junction Boxes for General Use Unclassified Areas Suitable for NEMA 12 Enclosures:
1. Material: 14 GA galvanized steel with seams continuously welded, ground smooth and no knockouts.
2. Zinc rich coating on all seams.
3. Stainless steel captivated cover screws threaded into sealed wells.
4. Flat door with oil resistant gasket.
5. NEMA 12 classification.
6. UL listed.

C. Pull and Junction Boxes for Wet Areas:
1. Material: 14 GA steel with polyester powder coating inside and out over phosphatized surfaces.
2. Seams continuously welded, ground smooth, no knockouts.
3. Stainless steel clamps on four sides.
4. Flat cover with oil resistant gasket.
5. NEMA 4 classification.
6. UL listed.

D. Pull and Junction Boxes for Corrosive Areas:
1. Material: 14 GA steel with powdered epoxy resin coating inside and out or fiberglass-reinforced polyester material.
2. Steel boxes:
   a. Seams continuously welded, ground smooth, no knockouts.
   b. Rolled lip around all sides.
   c. Hinged door.
   d. Captivated stainless steel door screws.
   e. Flat door with oil-resistant gasket.
3. Fiberglass-reinforced polyester boxes:
   a. Hinged door with latch and lockout.
   b. Neoprene door gasket.
   c. Grounding bushing(s).
4. NEMA 4X classification.

5. UL listed.

E. Pull and Junction Boxes for Hazardous Areas:
1. Material: Cast gray iron alloy or copper-free cast aluminum.
2. Drilled and tapped openings or tapered threaded hub equipped.
3. Flat bolted-down or threaded cover with neoprene gasket.
4. Stainless steel hex head screws.
5. Explosion-proof, UL listed for Class 1 Groups C and D.

F. Large Pull and Junction Boxes (100 CU IN and larger):
1. Located in offices and other dry architecturally finished areas where EMT is utilized:
a. NEMA 1 gasketed without knockouts.
2. Located in general use areas:
a. NEMA 12 construction:
1) Welded steel.
2) Furnished with gray enamel inside and out over phosphatized surfaces.
3. Located in wet and corrosive areas:
a. NEMA 4X with stainless steel screws.
b. Type 304 L welded stainless steel:
4. Constructed of 14 GA steel with seams continuously welded, ground smooth, no knockouts.
5. Rolled lip around all sides.
6. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
7. Split covers when heavier than 25 LBS.

G. Terminal Boxes:
1. Galvanized 16 GA steel box provided with plain blank screw cover, subpanel, and terminal points.
2. Refer to Drawing for dimensions and number of terminals.
3. Terminal blocks shall be screw-post barrier-type, white center marker strip.
4. Rated 20 ampere, minimum 600 V.

H. Fiberglass Cable-Pulling Enclosure:
1. Use: Access points to facilitate pulling of electrical cables in buried conduit runs.
2. Size and quantity: As shown on Drawings.
3. Type: Rectangular fiberglass composite, suitable for direct burial pedestrian traffic on top, -50 DegF, chemical, sunlight, and weather resistant.
4. Provide matching top with "ELECTRIC" logo.

I. Outlet Boxes:
1. Use: Installation of wiring devices.
2. Boxes for exposed conduit:
a. Zinc plated, cast, ferrous metal, with threaded hubs.
3. Boxes for concealed conduit:
a. Code gage, hot-dip galvanized steel.
b. Include bar hangers for metal stud partitions.
c. Provide barriers between switches in boxes with 277 V switches on opposite phases.
d. Use extension and plaster rings where required.
e. Provide grounding screw.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Use locknut and bushing for boxes in non-classified areas.

C. Use Type FS and FD boxes in wet areas and where exposed rigid steel conduit is required.

D. Use epoxy resin coated, stainless steel, cast aluminum or fiberglass boxes for corrosive areas.

E. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.

F. Paint boxes in accordance with Section 09905 and Section 16010.

G. Use outlet boxes sized to accommodate quantity of conductors enclosed.

H. Use boxes sized to accommodate conduit tying into box.

I. Install pull boxes or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
   1. Make covers of boxes accessible.

J. Install pull boxes or junction boxes rated for the area classification.

K. Install rigid conduit squarely into boxes that do not have hubs or are drilled and tapped.

L. Install with locknut on the outside and bushing on inside.

M. Install conduit into boxes with hubs, or that are tapped, using thread lubricant.

N. Do not use back-to-back boxes on this Project.

O. Seal all points of conduit entry into fiberglass cable-pulling enclosures for a waterproof installation.

P. Support outlet boxes for incandescent fixtures and other ceiling-mounted devices in lay-in acoustical tile ceilings by bar hangers anchored to ceiling construction members that do not interfere with tile removal.

END OF SECTION

SECTION 16140

WIRING DEVICES

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SECTION 16140

WIRING DEVICES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Light switches, receptacles, and device plates.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*
   3. Section 16130 - *Outlet, Pull, and Junction Boxes.*
   4. Section 16450 - *Grounding.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16010 - *Electrical: Basic Requirements.*

1.3 SUBMITTALS

A. Shop Drawings:
   1. Refer to Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Light switches:
      a. Hubbell.
      b. Eagle.
      c. P&S.
      d. Arrow Hart.
      e. General Electric.
      f. Leviton.
      g. Or approved equal.
   2. Explosionproof light switches:
      a. Crouse-Hinds.
      b. Appleton Electric Co.
      c. Killark.
      d. Or approved equal.
   3. Receptacles:
      a. Hubbell.
      b. Eagle.
      c. P&S.
      d. Arrow Hart.
      e. General Electric.
      f. Leviton.
      g. Or approved equal.
   4. Explosionproof receptacles:
      a. Crouse-Hinds.
      b. Appleton Electric Co.

c. Killark.
d. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 MATERIALS

A. Light Switches for Unclassified Areas:
1. Toggle type, quiet action, Standard Specification grade with grounding terminal.
2. Back and side wired.
3. Solid silver cadmium oxide contacts.
4. One-piece switch arm.
5. Rated 20 A, 120/277 V AC.
6. UL listed.
7. Color: Ivory.
8. Wall plate: Type 304 stainless steel.
9. SPST unless otherwise indicated on the Drawings.

B. Receptacles for Unclassified Areas:
1. Straight blade, grounding type, Standard Specification grade.
2. Back and side wired with wrap-around bridge.
3. Rated 20 A, 125 V AC.
4. UL listed.
5. Color:
a. For use on normal power: Ivory.
b. For use on UPS systems: Red.
c. For use on isolated ground systems: Orange.
6. Wall plate: Type 304 stainless steel.
7. Duplex unless otherwise indicated on the Drawings.

C. Light Switches for Wet Areas:
1. Presswitch type, quiet action, Standard Specification grade, with grounding terminal.
2. Back and side wired.
3. Solid silver cadmium oxide contacts.
4. One-piece switch arm.
5. Rated 20 A, 120/277 V AC.
6. UL listed.
7. Color: Ivory.
8. Wall plate: Gray weatherproof presswitch type.
9. SPST unless otherwise indicated on the Drawings.

D. Receptacles for Wet Areas:
1. Straight blade, grounding type, Standard Specification grade.
2. Back and side wired with wrap around bridge.
3. Rated 20 A, 125 V AC.
4. UL listed.
5. Color: Ivory.
6. Wall plate: Weatherproof in-use type, UL listed, NEMA 3R rated.
7. Clear polycarbonate cover.
8. Duplex unless otherwise indicated on the Drawings.

E. Ground Fault Circuit Interrupter Receptacles:
1. Straight blade, grounding type, Standard Specification grade.
2. Rated 20 A, 125 V AC.
3. UL listed.
4. Test and reset buttons.
5. Wall plate: Indoor or weatherproof as required.
6. Feed-thru type.

F. Light Switches for Corrosive Areas:
   1. Corrosion-resistant NEMA 4X enclosure with switch consisting of:
      a. Fiberglass reinforced polyester enclosure.
      b. Fiberglass reinforced polyester gasketed wall plate with built-in toggle lever switch with stainless steel shaft.
      c. Grounding bushing.
      d. Rated 20 A, 125 V AC.
      e. UL listed.
      f. SPST unless otherwise indicated on the Drawings.
      g. Color: Yellow.
   2. Optional: Corrosion-resistant enclosure and switch consisting of:
      a. Cast copper-free aluminum "FS" or "FD" ridge type hub box.
      b. Toggle type, quiet action, Standard Specification grade with grounding terminal.
      c. Rated 20 A, 125 V AC with solid silver cadmium oxide contacts.
      d. UL listed.
      e. Neoprene gasket.
      f. Cast aluminum cover with stainless steel screws and lever to activate switch.
      g. SPST unless otherwise indicated on the Drawings.
      h. Color: Yellow.

G. Receptacles for Corrosive Areas:
   1. Corrosion-resistant straight blade, grounding type, specification
   2. grade.
   3. Back and side wired with wrap-around bridge.
   4. Rated 20 A, 125 V AC.
   5. UL listed.
   6. Color: Yellow.
   7. Box: "FS" or "FD" ridge type cast hub box of copper-free aluminum.
   8. Gasket: Neoprene.
      a. Wall plate: Weatherproof in-use type, UL listed, NEMA 3R rated. Clear polycarbonate cover.
   9. Duplex unless otherwise indicated on the Drawings.

H. Explosionproof Light Switches for Use in Hazardous Areas:
   1. Explosionproof, UL listed for Class I, Division 1 and 2, Groups B, C,
   2. and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
   3. EDS factory sealed.
   4. Malleable iron body and cover.
   5. Aluminum sealing chamber.
   6. Front operated handle with stainless steel shaft.
   7. Rated 20 A, 125 V AC.
   8. With grounding screw.
   9. SPST unless otherwise indicated on the Drawings.

I. Explosionproof Receptacles for Use in Hazardous Areas:
   1. Explosionproof, UL listed for Class I, Division 1 and 2, Groups B, C,
   2. and D; and Class II, Division 1 and 2, Groups F and G.
   3. Factory-sealed malleable iron receptacle with spring-loaded cover.
   4. Malleable iron mounting box.
   5. Rated 20 A, 125 V AC.
   6. "Dead-front" construction requiring plug to be inserted and rotated to activate receptacle. Provide 4 mating plugs for Owner's use.
   7. Duplex unless otherwise indicated on the Drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Mount devices where indicated on the Drawings and as scheduled in Section 16010 - *Electrical: Basic Requirements*.

C. Surface mount receptacles and light switches in concrete construction.

D. In masonry and metal stud construction, recess mount receptacles and light switches unless device precludes recessed mounting or unless otherwise noted on the Drawings.

E. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.

F. Set switches and receptacles plumb and vertical to the floor.

G. Set recess-mounted switches and receptacles flush with face of walls.

H. Provide blank plates for empty outlets.

END OF SECTION

SECTION 16150

PANELBOARDS

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SECTION 16150

PANELBOARDS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Lighting panelboards and distribution panelboards, including panelboards mounted in Motor Control Centers.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*
   3. Section 16450 - *Grounding.*
   4. Section 16474 - *Motor Control Centers and Control Equipment.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. PB 1, Panelboards.
   2. National Fire Protection Association (NFPA):
      a. National Electric Code (NEC).
   3. Underwriters Laboratories, Inc (UL):
      a. 67, Panelboards.
      b. 50, Cabinets and Boxes.
      c. 489, Molded Case Circuit Breakers.
      d. 943, GFCI.
      e. 1449, Safety Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*
   2. Panel layout with alphanumeric designation, branch circuit breaker sizes and types, as indicated in the panel schedules.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Panelboards and circuit breakers:
      a. Square D.
      b. Cutler-Hammer.
      c. Siemens.
      d. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 MANUFACTURED UNITS

A. Panelboards:
   1. UL 67 listed.
   2. Designed in accordance with NEC Article 384.
   3. Dead-front type.
   4. Fronts:
      a. Steel reinforced.
      b. Concealed or semi-concealed hinges.
      c. Trim adjusting screws.
      d. Directory card mounted inside front door.
      e. Corrosionproof lock with retractable latch.
      f. Surface or flush mounting as required.
   5. Bus bars:
      a. Sequenced phased.
      b. Fully insulated.
      c. Drilled and tapped on circuit pole centers.
   6. Main lugs:
      a. Solderless type.
      b. Approved for copper and aluminum UL listed wire.
   7. Solid neutral bar with solderless mechanical type connectors.
   8. Non-insulated grounding strip including:
      a. Main ground lug.
      b. Individual grounding terminals for each circuit breaker and circuit breaker space.
   9. Maximum panel voltage:
      a. 240 V AC for lighting panelboards.
      b. 600 V AC for distribution panelboards.
   10. See Drawings for additional requirements.

B. Panel Boxes and Cabinets:
   1. UL 50 listed.
   2. Gutter space per NEC and UL requirements.
   3. Code gage galvanized steel.
   4. Furnish with knockouts in side, top and bottom panels.
   5. Nominal 5-3/4 IN deep.

C. Circuit Breakers:
   1. Current rating as indicated on the Drawings.
   2. Thermal-magnetic type, UL listed:
      a. Over-center, toggle handle operated.
      b. Quick-make, quick-break action.
         1) Independent of toggle handle operation.
      c. Common tripping of all poles.
      d. Molded-in ON and OFF markings on breaker cover.
      e. Bolt-on type.
      f. Three-position handles indicating ON, OFF and TRIPPED.
      g. Removable from front of panelboard without disturbing adjacent circuit breakers.
      h. One-, two- or three-pole as indicated on the Drawings.
      i. Rated 10,000 AIC, minimum, unless a higher interrupting rating is noted on the Drawings.
      j. Tandem or half-size circuit breakers shall not be used.
   3. GFCI type, UL listed:
      a. Characteristics as indicated for the thermal-magnetic type above:
         1) Except one- or two-pole as indicated on the Drawings.
         2) Plus the following features:
            a) Class A ground fault circuit.
            b) Trip on 5 mA ground fault (4-6 mA range).

2.3 ACCESSORIES

A. Surge Protective Device (SPD):
   1. Provide surge suppressor at main bus in 480 volt panelboards where indicated on drawings.
      a. System voltage: 480Y/277, 3-phase, 4W.
      b. Maximum operating voltage: 320V L-N, 640V L-L.
      c. Frequency range: 0-4000 Hz.
      d. Peak surge current: 120,000 amps.
      e. Response time: ≤1nanosecond.
      f. Protection: Normal mode, common mode.
      g. Approvals: UL 1449, CSA.
      h. Short circuit protection: Integral fuses, 200,000 AIC.
      i. Manufacturer: Cutler Hammer Clipper Visor CPS-120 or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install per manufacturer's instructions.

B. Install in accordance with the NEC.

C. Provide each panelboard with a typed "as installed" directory.

END OF SECTION

SECTION 16190

DRY TYPE TRANSFORMERS

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SECTION 16190

DRY TYPE TRANSFORMERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dry-type transformers, including transformers mounted in Motor Control Centers.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*
   3. Section 16450 - *Grounding.*
   4. Section 16474 - *Motor Control Centers and Control Equipment.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C89.2, Dry-Type Transformers for General Applications.
   2. National Electrical Manufacturers Association (NEMA):
      a. ST 20, Dry-Type Transformers for General Applications.
   3. Underwriters Laboratories Inc.(UL):
      a. 506, Specialty Transformers.
      b. 1449, Safety Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*
   2. UL nameplate data.
   3. Certifications:
      a. Sound level certifications.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Dry-type transformers:
      a. Square D.
      b. Cutler-Hammer.
      c. Siemens.
      d. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 MANUFACTURED UNITS

A. Dry-Type Transformers:
   1. UL 506 listed.
   2. Ventilated or non-ventilated, air cooled, two winding type.
   3. Cores: High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point.
   4. Coils: Continuous wound construction and impregnated with non-hygroscopic, thermosetting varnish.
   5. Mount core-and-coil assemblies of transformers on rubber isolation pads.
   6. Furnish taps for transformers as follows:
      a. 1 PH, 25 KVA and below: Two 2-1/2 percent FCAN and two 2-1/2 percent FCBN.
      b. 3 PH, 15 KVA and below: Two 2-1/2 percent FCAN and two 2-1/2 percent FCBN.
      c. 3 PH, 30 KVA and above: Two 2-1/2 percent FCAN and four 2-1/2 percent FCBN.
   7. Sound levels: Manufacturer shall guarantee not to exceed the following:
      a. 5 to 50 KVA: 50 dB.
   8. Transformers shall meet or exceed ANSI C89.2 and NEMA ST 20 requirements.
   9. Insulating material (600 V and below): In accordance with NEMA ST 20 standard for a 220 DegC UL component recognized insulation system.
   10. Voltage, KVA rating, and phase as indicated on the Drawings.

B. Accessories for General Purpose Dry-Type Transformers:
   1. Painted metal wall brackets.
   2. UL listed weathershield kit.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Ground in accordance with Section 16450 - *Grounding*.

END OF SECTION

SECTION 16429

LOW VOLTAGE SWITCHBOARDS

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SECTION 16429

LOW VOLTAGE SWITCHBOARDS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Main Switchgear MSG.
   2. Main distribution switchboards MDS-A, MDS-B.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical General Requirements*.
   3. Section 16450 - *Grounding*.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. PB2, Deadfront Distribution Switchboards.
   2. National Fire Protection Association (NFPA):
      a. National Electrical Code (NEC).
   3. Underwriters Laboratories (UL):
      a. 891, Standard for Dead-Front Switchboards.
      b. 1449, Safety Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements*.
   2. Provide time-current curves for each type and rating of circuit breaker used.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals*.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Cutler-Hammer.
   2. Square D Company.
   3. GE Company.
   4. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 DESIGN REQUIREMENTS

A. Ratings:
   1. Rated 480 V, 3 PH, 4 wire.
   2. Main bus current rating: As shown on the Drawings.

3. Bus withstand and circuit breaker interrupting rating: As shown on the Drawings or specified.
4. Switchboards to be rated as Service Entrance Equipment unless otherwise indicated on the Drawings.

B. Structure:
1. NEMA 1 indoor use:
   a. Ambient temperature range of 0 to +40 DegC.
   b. Completely enclosed, dead-front, self-supporting metal structure.
   c. Vertical panel sections bolted together.
   d. Provide frames bolted together to support and house bus, cables and other equipment.
   e. Provide frames and insulating blocks to support and brace main buses for short circuit stresses up to ratings indicated on the Drawings.

C. Arrangement:
1. Front and rear access.
2. Arrange switchboard as shown on the Drawings.
   a. Double ended switchboard with two main circuit breakers configured for dual utility feeds.
   b. Bus sectionalizing tie breaker.
   c. Two sectionalized main distribution sections.
3. Verify space required with space allocated.
   a. Failure to design switchboard to fit available space may be cause for rejection of the equipment.

D. Buses:
1. Main horizontal bus:
   a. Silver-plated copper:
      1) Sufficient size to limit temperature rise to 65 DegC over average air temperature outside the enclosure of 25 DegC.
      2) Rating as shown on the Documents.
      3) Fully rated and continuous over length of switchboard.
      4) Fault current withstand rating minimum 65 KAIC RMS symmetrical unless otherwise shown on the drawings.
2. Main bus tap connections:
   a. Silver plated over full surface of the joints.
   b. Current density shall not exceed:
      1) Copper: 1250 amp per SQ IN.
   c. Use four through bolts at each connection for maximum conductivity.
3. Ground bus:
   a. Continuous over length of switchboard.
   b. 1/4 x 2 IN copper.
   c. Solidly grounded to each structure.
4. Neutral bus:
   a. Suitable for incoming line and outgoing feeder terminations and bonding to ground.

E. Miscellaneous Features:
1. Provide circuit protective devices and other associated equipment as indicated on the Drawings.
2. All control wiring shall:
   a. Be neatly laced.
   b. Have flexibility at hinge locations.
3. Tag switchboard and all circuit breakers identifying equipment and circuit fed.

F. Feeder Circuit Breakers:
1. Molded case type as required.
2. Frame size/current sensor, rating plug and trip setting as shown on the Drawings.

3. Thermal magnetic or solid-state trip:
    a. Frame size 150 amp and below:
        1) Non-interchangeable, non-adjustable thermal magnetic trip units.
    b. Frame size 225 amp:
        1) Interchangeable and adjustable thermal magnetic trip units.
    c. Frame size 400 amp and above:
        1) Solid-state trip units:
            a) Fixed current sensor.
            b) Interchangeable rating plug, minimum range 50 to 100 percent of current sensor rating.
            c) Adjustable current setting, minimum range 70 to 100 percent of rating plug.
            d) Adjustable delay, minimum of three taps.
            e) Adjustable instantaneous pick-up, minimum range 3 to 8 times rating plug.
4. Integral ground fault protection on frame sizes 1000 amp and above and on all main circuit breakers frame size 400 amp and above.
    a. Adjustable pickup, minimum range 0.2 to 0.6 times current sensor.
    b. Adjustable delay, minimum of three taps.
5. Fault interrupting rating equal to or greater than main bus fault withstand rating.
6. Thermal capability:
    a. Frame size 1200 amp continuous and below:
        1) Shall be provided for use at 80 percent of their continuous rating unless otherwise indicated on the Drawings.
    b. Frame size 1600 amp continuous and above:
        1) Shall be UL listed for application in their intended enclosure for 100 percent of their continuous rating.
        2) Wiring associated with these circuit breakers shall have a dry location maximum operating temperature of 90 DegC.
7. Trip/Close mechanism:
    a. Common trip.
    b. Clearly indicate ON, OFF and TRIPPED.
    c. Frame size 1600 amp and above, fast acting, 6 cycle trip.
    d. Operation:
        1) Frame size 1200 amp and below manually operated, unless otherwise indicated on the Drawings.
        2) Frame size 1600 amp and above electrically operated.
8. Mounting:
    a. Main and tie circuit breakers shall be a part of the automatic transfer switch.
    b. Feeder circuit breaker:
        1) Frame size 1200 amp and below group mounted, unless otherwise indicated on the Drawings.
        2) Frame size 1600 amp and above individually mounted.

2.3 MAIN AND TIE CIRCUIT BREAKERS

A. Ratings:
1. Main and Tie circuit breakers shall have withstand, closing and interrupting ratings of 100,000 amperes, symmetrical at 480 volts.
2. Voltage rating of the circuit breakers shall be no less than the system voltage rating. Circuit breakers shall be 100% rated.

B. Construction:
1. Main and tie protective devices shall be drawout low voltage power air circuit breakers rated as shown on the drawing.
    a. Breakers shall be electrically operated using 120 VAC control power derived from the line side of the source to which the load is transferred.
    b. Breakers shall be equipped with a two step stored energy mechanism with sufficient capacity for one closure and subsequent opening without recharge. The stored energy mechanism shall be charged by an electric motor with manual charging capability in the absence of control power.

c. Breakers shall be capable of manual operation using Close/Open pushbuttons with indicating lights to display the contact position and a charged/discharged indicator on the face of the breaker case.
d. Breakers shall be constructed in compliance with the following standards:
   1) ANSI C37.13, C37.16, C37.17, C37.50.
   2) NEMA SG3.
   3) U.L. 1066.
e. Breakers shall be provided with a microprocessor based electronic trip unit with true RMS sensing and flux transfer actuator.
   1) Fixed rating plug.
   2) Overtemperature trip.
   3) Adjustable long delay pick-up and time.
   4) Adjustable short delay pick-up and time.
   5) Adjustable instantaneous pick-up.
   6) Adjustable ground fault delay pick-up and time.
   7) Trip mode indicator with manual reset.
f. Breaker mounting cells shall be equipped with draw-out rails and primary and secondary disconnect devices employing silver to silver contact surfaces..
   1) Worm gear racking mechanism.
   2) Mechanical interlock to insure breaker is tripped prior to racking.
   3) Top rail mounted hoisting mechanism.
g. Breakers shall include padlocking provisions.
h. Breakers shall be Cutler Hammer Magnum DS with Digitrip 520 trip units or approved equal.

2.4 ACCESSORIES

A. Surge Protective Device (SPD):
   1. Provide surge suppressors at main bus for each source where indicated on drawings.
      a. System voltage: 480Y/277, 3-phase, 4W.
      b. Maximum operating voltage: 320V L-N, 640V L-L.
      c. Frequency range: 0 - 4000 Hz.
      d. Peak surge current: 250,000 amps.
      e. Response time: ≤1 nanosecond.
      f. Protection: Normal mode, common mode.
      g. Approvals: UL 1449, CSA.
      h. Short circuit protection: Integral fuses, 200,000 AIC.
      i. Manufacturer: Cutler Hammer Clipper Visor CPS-250 or approved equal.

B. Digital Metering Module:
   1. Self powered with internal 3 phase fuses.
   2. Current input: 3 Phase 3000:5 CT, true RMS.
   3. Voltage input: 3 Phase 120V PT, true RMS.
   4. Frequency: 20-66 Hz.
   5. Harmonic response: 50^{th} Harmonic.
   6. ANSI C12-20 Class 0.5% accuracy.
   7. Metered and Monitored Parameters:
      a. Currents: Phase, Neutral, and Ground.
      b. Voltages: L-L, L-N, Average L-L, Average L-N, N-G.
      c. Power: Real, Reactive, Apparent.
      d. Frequency.
      e. Power factor.
      f. Energy and demand.
      g. Individual current and voltage harmonics.
      h. % THD, current and voltage.
      i. Min/Max values.
      j. Event logging.
   8. Backlit LCD display.
   9. Programmable digital and analog outputs.

10. Cutler Hammer IQ Analyzer 6400 or approved equal.
11. Provide two units, one on each utility service.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install switchboards in accordance with manufacturer's instructions.

B. Switchboard locations are shown on the Drawings.

C. Install switchboard on 4 IN high concrete housekeeping pad.
   1. Align front of switchboard with top edge of pad chamfer.

3.2 FIELD QUALITY CONTROL

A. Set all circuit breaker adjustable taps as defined in the coordination study.

B. Test and verify all circuit breaker trip functions using a test set provided by the manufacturer for that purpose.

C. Test ground fault function as required by the NEC.

END OF SECTION

SECTION 16450

GROUNDING

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SECTION 16450

GROUNDING

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Grounding.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 13440 - *Instrumentation for Process Control: Basic Requirements.*
   3. Section 13448 - *Control Panels.*
   4. Section 16010 - *Electrical: Basic Requirements.*
   5. Section 16111 - *Conduit, Conduit Fittings, Conduit Supports.*
   6. Section 16120 - *Wire and Cable - 600 Volt and Below.*

1.2 QUALITY ASSURANCE

A. Assure ground continuity is continuous throughout the entire Project.

B. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   2. National Fire Protection Association (NFPA):
      a. National Electric Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 467, Electrical Grounding and Bonding Equipment.
      b. 1449, Safety Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenonce Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*
   2. Grounding system details for:
      a. Building grounding system.
      b. Service entrance grounding.
      c. Equipment grounding.

PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Wire and cable:
      a. As specified in Section 16120 - *Wire and Cable - 600 Volt and Below* except as modified in the following:
   2. Conduit:
      a. As specified in Section 16111 - *Conduit, Conduit Fittings, Conduit Supports.*
   3. Ground rods:
      a. Thompson.
      b. Joslyn.
      c. Heary Brothers.

d. Or approved equal.

4. Grounding clamps and connectors:
   a. Thompson.
   b. Burndy.
   c. Heary Brothers.
   d. Joslyn.
   e. Or approved equal.
5. Exothermic weld connections:
   a. Erico Products Inc., Cadweld.
   b. Burndy.
   c. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 COMPONENTS

A. Wire and Cable:
1. As specified in Section 16120 - *Wire and Cable - 600 Volt and Below* except as modified by the following.
2. Grounding electrode conductor:
   a. Bare copper ground cable:
      1) Soft drawn stranded bare copper cable.
      2) ASTM B8.
   b. Sized as required by Table 250-66 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
      1) Minimum conductor allowed: 2/0 unless otherwise shown on Contract Drawings.
3. Grounding conductor:
   a. Bare copper ground cable:
      1) Soft drawn stranded bare copper cable.
      2) ASTM B8.
   b. 2/0 unless otherwise shown on Contract Drawings.
4. Equipment grounding conductor:
   a. Green copper conductor: Identical insulation to phase conductors.
   b. Sized as required by Table 250-122 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
   c. Conduit: As specified in Section 16111 - *Conduit, Conduit Fittings, Conduit Supports*.

B. Grounding Clamps:
1. High copper alloy content: Compression type.
2. UL 467 listed.
3. Noncorrosive.

C. Ground Rods:
1. 3/4 IN x 10 FT, except as otherwise indicated on the Contract Drawings.
2. Copperclad:
   a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
   b. Corrosion resistant bond between the copper and steel.
3. Hard drawn for a scar-resistant surface.
4. UL listed.

D. 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. Remove paint, rust, or other nonconducting material from contact surfaces before making ground connections.
   3. Where ground conductors pass through floor slabs or building walls, sleeves of intermediate metal conduit of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.

B. Ground Grid:
   1. Locate ground rods at approximate locations shown on Drawings.
   2. Install rods in firm soil outside of excavated areas.
   3. Place perimeter rods a minimum of 6 FT from the building foundation.
   4. Drive top of rod to minimum depth of 2 FT below grade unless otherwise noted on Contract Drawings.
   5. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
   6. Interconnect all ground rods with ground electrode conductor:
      a. Sized per the NEC unless a larger size is shown on the Drawings.
   7. Do not splice grounding electrode conductor.
   8. Provide excavation required for installation of ground conductors buried in earth.
   9. Allow sufficient slack to prevent conductor breakage during backfill or due to ground movement.
   10. Leave taps, junctions, and splices uncovered until inspected by Engineer.
   11. Backfill around ground grid completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
   12. Bond underground metal piping to the ground grid in accordance with NEC 250. Grounding clamps may be utilized on piping if exothermic welds may damage structural integrity.
   13. All underground connections: Exothermically welded.
   14. Complete grid system:
      a. Resistance of 5 ohms or less.
      b. Drive additional rods as required.

C. Raceway Grounding-Conduit:
   1. All metallic conduit shall be electrically continuous.
   2. Provide grounding-type insulating bushings:
      a. For all equipment not supplied with a conduit hub.
      b. On ends of metallic ductbank conduit.
   3. Bond all conduit, at entrance and exit of equipment, to equipment ground bus or ground lug.
   4. Use double locknuts at all panels.
   5. Provide bonding jumpers if conduit are installed in concentric knockouts.
   6. 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.
   7. Provide bonding jumper from equipment ground lug to RGS conduit, if flexible conduit is utilized for equipment connections.
   8. Provide bonding jumpers identical in conductor size to the largest ground conductor run within the conduit.

D. Equipment Grounding:
   1. Ground all voltage levels at the supply transformer from the secondary neutral to the ground grid. Provide two separate grounding conductors.

2. Provide a grounding conductor between the supply transformer and the grounding buses of all supplied MCC's and/or switchgear.
3. Ground all equipment supplied from an MCC or switchgear through the distribution equipment ground bus. Provide an equipment grounding conductor connected to the ground bus and equipment ground lug.
4. Provide two separate grounding conductors for bonding all MCC and switchgear ground buses to the ground grid.
5. Bond MCCs and/or switchgear fed from other distribution equipment to that equipment.
6. Bond 480:120/208 V AC transformers and lighting panels to the supplying MCC ground bus.
7. Ground all equipment fed from lighting panels through the lighting panel ground bus. Provide ground conductors for all connections.
8. Consider control devices (switches, indicating lights, meters, starters, relays, etc.) mounted in MCCs, switchgear, control panels, or other metal enclosures to be adequately grounded, if the enclosure ground lug or ground bus is properly grounded.
9. Do not splice grounding conductors.
10. Run all equipment grounding conductors in conduit.
11. Provide separate grounding conductors bonded to the ground grid for all DC equipment.
12. Provide a bare 2/0 conductor bolted to the motor frame and connected to the ground grid, for all motors 100 HP and larger.
13. Ground cranes and hoists in accordance with NEC 610.61.
14. Provide surge arresters for:
    a. All instrumentation cables entering or leaving a building. (See Division 13 for additional requirements.)
    b. Secondary side of the service transformer.
    c. Engine-generator set generator output terminals.
        1) Use generator manufacturer's provisions for grounding electric generators, or manufacturer's written instructions, except as shown on the Contract Drawings.
        2) Ground unused and spare power and control cable at both ends.
        3) Size all grounding conductors in accordance with Tables 250-66 and 250-122 of the NEC unless larger size is shown on the Drawings.

E. Structural Grounding:
1. Bond concrete foundation reinforcing steel to the ground at all corners of the structure and at locations along the perimeter. Maximum spacing between bonds shall not exceed 50 FT. Utilize a bare 2/0 conductor, unless otherwise shown on Contract Drawings. Do not use exothermic welding if it will damage structural integrity of the foundation.
2. Make all reinforcing steel electrically continuous.

3.2 FIELD QUALITY CONTROL

A. Test resistance of installed ground system after backfilling and before connection to any other grounded system including underground piping, utility services or other building ground systems.
1. Test ground grid resistance by fall-of-potential method.

END OF SECTION

SECTION 16472

VARIABLE FREQUENCY DRIVES AND SOLID STATE REDUCED VOLTAGE STARTERS

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SECTION 16472

VARIABLE FREQUENCY DRIVES AND SOLID STATE REDUCED VOLTAGE STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. General
   1. Furnish all labor, materials, tools, equipment, and services for all variable frequency drive (VFD) equipment, and solid state reduced voltage starters (SSRV) as indicated, in accordance with provisions of the Contract Documents.
   2. Completely coordinate with work of all other trades.
   3. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work.
   4. See Section 16010 - *Electrical General Requirements* for general electrical requirements.

1.2 SUBMITTALS

A. Shop Drawings
   1. Supply descriptive product information.
   2. Complete master wiring diagrams, elementary control schematics including interconnection and coordination with other electrical control devices operating in conjunction with the VFD.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Acceptable Manufacturers:
   1. Benshaw

B. Motors: Verify all motor sizes and specifications from approved mechanical, process, and instrumentation shop drawings, contract drawings, and Contract Documents.
   1. It is the responsibility of the Contractor to fully coordinate the variable frequency drive equipment with the motors and associated equipment to provide a totally integrated, operational system.

C. The variable frequency drives shall be the 18 pulse type with main circuit breaker and solid state reduced voltage bypass starters, and shall consist of a 480-volt adjustable frequency inverter with integral control, sequence logic, and self-diagnostics as specified hereinafter. The drives shall be of "pulse width modulated inverter" (PWM) type employing IGBT power semi-conductor technology.
   1. The VFD shall limit harmonic distortion reflected onto the system to a voltage and current distortion level as defined by IEEE 519 for general system application.

D. The variable frequency drives shall be rated constant torque, 480 volt, 3-phase, 60 HZ. The VFDs shall be a microprocessor-based static adjustable frequency controller designed to provide continuous-speed adjustment of 3-phase motors. The adjustable frequency output voltage shall provide constant volts per hertz excitation to the motor terminals up to 60 HZ. The VFDs shall provide energy-efficient, low-loss speed control in the range from 4 to 60 HZ.

E. VFDs shall be provided with input surge protection.

2.2 PERFORMANCE REQUIREMENTS

A. Service Factor: 1.0 continuous, 110% current for 1 minute.

B. VFD shall have a full load current greater than the motor nameplate current.

C. Guaranteed Minimum Efficiency, including all auxiliary equipment such as cooling fans, etc. and harmonic distortion mitigation devices: 96%.

D. Output Frequency: .5-120 Hz.

E. Resolution: 0.01 Hz.

F. Accuracy: 0.01%.

G. Audible VFD Noise: Not greater than 85dBA at 1 meter at full load.

H. Power Loss Ride-through: Less than 1 cycle.

2.3 ENVIRONMENTAL REQUIREMENTS

A. Temperature: 0 - 40°C (32°F to 104°F).

B. Relative Humidity: Up to 95%, non-condensing.

C. Input Power: 480V AC, 3Ph, +/- 10% 50-60 Hz, +/- 3Hz.

2.4 ENCLOSURE

A. The VFD(s) cabinets shall be NEMA 1 with fans and filters. The VFD(s) and any required accessories or auxiliary items shall fit within the space shown on the Plans. Any costs associated with furnishing equipment that exceeds the available space shall be borne by the Contractor.

2.5 DISCONNECTING DEVICE

A. Each VFD shall be provided with an input circuit breaker rated with an interrupting rating of 100,000 Amperes at 480V. The breaker shall be provided with a shunt trip.

2.6 CONVERTER

A. The converter shall limit Voltage and Current distortion produced by the VFD to within the limits cited in IEEE 519-1992, Table 10-3. A preliminary Harmonic Distortion Analysis shall be provided with the bid to indicate conformance. The analysis shall be based on the 1-line diagram as shown in the Plans, and assume all units operating simultaneously at full speed, full load. Tie breakers if present, shall be modeled as open. The point of common coupling for current distortion measurements and modeling shall be the line side of each VFD circuit breaker.

B. The converter shall be an 18-pulse type, consisting of an integral phase shifting transformer and three paralleled 3 phase full wave type converter bridges.

C. The VFD system shall also include a 7.5% impedance AC reactor.

D. The 18 pulse transformer shall use copper windings.

E. The VFD system shall consist of a 6 pulse VFD chassis with a UL recognized diode section providing an additional 12 diodes. The 18 pulse system shall be modular in that upon failure of any of the additional 12 pulse diodes or 18 pulse transformer, the VFD shall be able of being operated as a 6 pulse unit.

F. The VFD system shall be provided with input fuses.

2.7 INVERTER

A. The inverter section shall utilize IGBT devices.

B. Output waveform to contain not more than 5% current harmonics.

C. Able to withstand full-speed, full load short circuits without component damage.

2.8 CONTROL LOGIC

A. Space vector controlled modulation to minimize motor noise.

B. Protective circuitry to shutdown VFD without damage in the event of an overload.

C. 32-bit digital signal processor.

D. Multiple motor profiles.

E. Multiple accel and decel patterns, 0.1 - 6,000 seconds:
   1. Linear for constant torque.
   2. Squared for variable torque loads.
   3. User defined.
   4. Auto boost to optimize V/Hz curve at low speeds.

F. Multiple stall prevention modes.

G. Proportional, integral, and derivative control.

H. The VFD shall have wired to a user terminal strip:
   1. 1 Form C run contact.
   2. 1 Form C fault contact.
   3. Hand mode indication.
   4. Auto mode indication.
   5. Bypass mode indication.

2.9 OPERATIONAL FEATURES

A. Programmable fixed carrier frequency. Automatic derating shall not be allowed.

B. 0-10VDC, -10V to 10Vdc or 4-20mA input, direct or reverse acting.

C. Diagnostics and fault log histories. Display the following, in English:
   1. Overvoltage
   2. Low voltage.
   3. Overcurrent.
   4. Ground fault.
   5. Overtemperature.
   6. Blown DC bus fuse.
   7. Overload.
   8. Motor overload.
   9. External trip.

D. 1 Form "C" fault relay output, rated 1A, 250 VAC.

E. 4 form "A" software programmable output relays, rated 1A, 250 VAC.

F. User selectable (up to 10 attempts) Auto Restart.

G. Restart into a spinning load.

H. The VFD shall have a power on time meter.

I. The VFD shall have a time between faults meter.

J. The VFD shall have a run time meter.

K. The VFD shall have a software selectable parameter to select parameters that have been changed from default. This function shall be used in troubleshooting the VFD and only show parameters that have been changed from default settings.

L. The VFD shall have an autotuning function to tune to the motors parameters. Volts / Hz drives will not be accepted.

M. The VFD shall be provided with an intelligent keypad which can upload and download parameters. The keypad shall be transferable and be able to move parameters from one VFD to another.

2.10 DOOR MOUNTED CONTROLS

A. 32-character backlit LCD display. LED displays are not acceptable.

B. Plain English programming.

C. VFD - Off - Bypass Selector switch.

D. Green "Running" light.

E. Red "Bypass" light.

F. Amber "Stand By" light.

G. Temperature monitor.
   1. Temperature monitor/control shall be Minco Model CT124, 8 channel, to display the output of six TRDs (two per phase).
   2. Monitor/control shall stop the motor if high temperature is detected in the motor.
   3. Reset from the stopped condition shall be manual.

H. High pressure alarm light.

I. High pressure alarm reset push button switch.

J. Low wetwell level alarm light.

K. Low wetwell level alarm reset push button switch.

2.11 BYPASS CIRCUIT

A. Each VFD system shall be provided with a three contactor bypass circuit. The VFD shall be provided with a bypass contactor and a VFD output contactor. The output contactor and bypass contactor shall be mechanically and electrically interlocked. A third contactor shall be provided to provide isolation to the VFD input when in bypass mode.

B. An OL relay shall be provided to protect the motor when in bypass mode.

C. The VFD system shall contain a reduced voltage solid state starter for bypass mode. The solid state starter shall be a microprocessor based starter and have integral bypass contactors to remove heat from the system after the motor is up to speed.

2.12 WINDOWS BASED SOFTWARE

A. The VFD system shall be provided with a windows based software package. The software will allow uploading and downloading parameters, monitoring digital and analog inputs, providing a real time event recorder and be able to print parameter reports in an Excel format.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Provide services of factory-trained technician for inspection, programming, startup, and certification of completed installation. Provide minimum eight (8) hours on site for startup and additional four (4) hours on site for operator training in two separate sessions of two hours each.

END SECTION

SECTION 16475

SAFETY SWITCHES

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SECTION 16475

SAFETY SWITCHES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Safety switches.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*
   3. Section 16111 - *Conduit, Conduit Fittings, Conduit Supports.*
   4. Section 16450 - *Grounding.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. See Section 16010.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*
   2. Provide a tabulation showing safety switch and equipment coordination.
   3. Identify each item of equipment requiring a safety switch, and show catalog number of safety switch provided for that equipment.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:
   1. Cutler-Hammer.
   2. Square D.
   3. Siemens.
   4. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 SAFETY SWITCHES

A. General:
   1. Non-fusible, unless otherwise indicated.
   2. NEMA Type HD heavy-duty construction.
   3. Minimum of a NEMA 12 enclosure.
   4. Switch blades will be fully visible in the OFF position with the enclosure door open.
   5. Contact operation will be quick-make, quick-break.
   6. Provide padlocking provisions in OFF position.
      a. Minimum of three-padlock capability.

7. UL 98 listed.

B. Weatherproof Switches:
   1. NEMA 4 stainless steel type watertight enclosures.
   2. Switches for use outdoors with HVAC equipment may be NEMA 3R enclosure.

C. Corrosion-Resistant Switches:
   1. NEMA 4X stainless steel enclosure.
   2. Crouse-Hinds "Krydon" enclosure.
   3. Explosionproof Switches:
   4. NEMA 7/9 cast aluminum enclosures.
   5. Crouse Hinds or Appleton Electric.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's instructions and recommendations.
   1. Securely mount and support safety switches.
      a. Switch enclosures will not vibrate, turn or shake when the handle is actuated.
   2. Switches shall be installed adjacent to the equipment they are intended to serve unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 16501

LAMPS

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SECTION 16501

LAMPS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Lamps.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*
   3. Section 16510 - *Interior Lighting.*
   4. Section 16525 - *Exterior Building Lighting.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16010 - *Electrical: General Requirements.*

B. Miscellaneous:
   1. Lamps are identified for each luminaire in the Lighting Fixture Schedule on the Drawings.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Section 16010 - *Electrical: Basic Requirements.*

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. General Electric.
   2. Phillips.
   3. Osram-Sylvania.
   4. Or approved equal.

2.2 MATERIALS

A. General:
   1. See lighting fixture schedule on drawings for wattage, voltage and number required.

2.3 MAINTENANCE MATERIALS

A. Spare Parts:

1. Furnish Owner with a minimum of two lamps or 20 percent of total of each type and watt rating, whichever is greater.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install lamps in all luminaires.

B. Replace all incandescent lamps operated during construction and all failed fluorescent, metal halide, mercury vapor and high pressure sodium lamps with new lamps prior to final acceptance by Owner.

1. Relamping is to be done at end of Project.

END OF SECTION

SECTION 16510

INTERIOR AND EXTERIOR LIGHTING

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SECTION 16510

INTERIOR AND EXTERIOR LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior and exterior lighting.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: Basic Requirements.*
   3. Section 16130 - *Outlet, Pull, and Junction Boxes.*
   4. Section 16450 - *Grounding.*
   5. Section 16501 - *Lamps.*

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. See Section 16010 - *Electrical: Basic Requirements.*

B. Miscellaneous:
   1. Lighting fixtures and electrical components:
      a. UL labeled.
      b. Rated for area classification as indicated on Drawings.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Sections 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals* and 16010 - *Electrical: Basic Requirements.*
   2. Photometric performance curves for fixtures.
   3. Identification of fixtures by Lighting Fixture Schedule number.
   4. Finishes, colors, and mountings available.
   5. Ballast data.

B. Operation and Maintenance Manuals:
   1. See Section 01340 - *Shop Drawings, Product Data & Samples; Operation and Maintenance Manuals; and Miscellaneous Submittals.*

1.4 WARRANTY

A. Warrant lenses to provide satisfactory performance without objectionable discoloration.

PART 2 – ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Lighting fixtures: As indicated in Article 2.02 below.
   2. Ballasts:
      a. Valmont (General Electric).
      b. Advance.
      c. Jefferson.
      d. Universal.
      e. Bodine.
      f. Lithonia.

g. Or approved equal.

2.2 MANUFACTURED UNITS

A. All Fixtures:
   1. Fabricate fixtures as a complete unit ready to be mounted and wired in field.
   2. Fixtures to be furnished with lamps.
   3. Provide pendant fixtures with swivel hangers which allow fixture to swing in any direction without allowing stem to rotate.
   4. Finish fixtures in manufacturer's standard polyester or acrylic enamel or epoxy powder coating.
   5. Reflector coating to have a minimum 89 percent reflectance factor.
   6. There shall be no live parts normally exposed to contact.
   7. When intended for use in wet areas:
      a. Mark fixtures "Suitable for wet locations."
   8. When intended for use in damp areas:
      a. Mark fixtures "Suitable for damp locations" or "Suitable for wet locations."
   9. The fixture schedule in the Contract Drawings:
      a. Identifies the required fixtures:
      b. Establishes a standard of quality including, but not necessarily limited to:
         1) Construction features.
         2) Materials of construction.
         3) Finish.
         4) Photometrics.

B. Submit requests for substitution in accordance with Division 1.

2.3 ACCESSORIES

A. Photoelectric Cell:
   1. Enclosed, weatherproof, for outdoor application.
   2. Rated: 120V AC, 60HZ.
   3. Provide time delay to eliminate nuisance switching.
   4. Temperature compensated.
   5. Spectrum response permitting cell to face any direction except due south.
   6. Light level selector.
   7. Surge protected.
   8. Mounting: Wall, rood or fixture, as indicated in the Lighting Fixture Schedule.

PART 3 — EXECUTION

3.1 INSTALLATION

A. Install lighting fixtures, where shown and at heights indicated or as detailed on Drawings.

B. Provide mounting brackets and/or structural mounting support for wall-mounted fixtures.
   1. Do not support fixture from conduit system.
   2. Do not support fixture from outlet boxes.

C. Provide pendant fixtures with swivel hangers which allow fixture to swing in any direction without allowing stem to rotate.
   1. Hangers to have same NEMA enclosure rating as light fixtures.
   2. Provide shock absorbing type swivel hangers on light fixtures in mechanical equipment areas.

D. Fixtures and ballasts shall be grounded.

END OF SECTION

SECTION 16858

HEAT TRACING

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SECTION 16858

HEAT TRACING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes.
   1. Conduit, wiring and heat tape as required for heat tracing of pipes and equipment as indicated on the drawings.

B. Related sections include but are not necessarily limited to.
   1. Division 1 - General Requirements.
   2. Section 16010 - *Electrical: General Requirements.*
   3. Section 16130 - *Outlet, pull and junction boxes.*

1.2 QUALITY ASSURANCE

A. Referenced standards:
   1. See Section 16010

1.3 SUBMITTALS

A. Shop drawings:
   1. Refer to Sections 01340 and 16010.
   2. Provide wiring diagrams showing physical locations of thermostats and heat trace power supply.
   3. Technical data:
      a. Heat trace catalog number and proposed use.
      b. Power requirements for each circuit based upon actual length of heat trace and maintained temperature.
      c. Circuit breaker rating based on inrush current at minimum expected start-up temperature.
      d. Length of heat tape for each pipe size and run.
      e. Thermostats.
   4. Coordinate and verify length of heat tape required based on pipe size and insulation.

1.4 DELIVERY, STORAGE AND HANDLING

A. Shall be stored so that they are not exposed to sunlight or other UV rays.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
   1. BTV-1 by Raychem Corp.
   2. Or approved equal.

B. Submit requests for substitution in accordance with Division 1.

2.2 GENERAL

A. Furnish and install a complete UL Listed system of heating cables, components, and controls to prevent pipes from freezing.

2.3 DESIGN AND FABRICATION

A. The self-regulating heating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating conductive core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of modified polyoefin per section 427-23 of the NEC 2005.

B. In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of at least 90 percent. The self-regulating factor is defined as the percentage reduction, without thermostatic control, of the heating cable output going from 40°F pipe temperature operation to 150°F pipe temperature operation.

C. The heating cable shall operate on line voltages of 120 volts AC, 60HZ without the use of transformers.

D. Heating cable shall be FM approved and UL listed for use in Class I, Div. 2, Group D hazardous areas.

E. The heating cable shall be suitable for metal or plastic pipe freeze protection and shall be rated minimum five (5) watts per foot at 50°F based on 1 inch fiberglass insulation.

F. Power connection, end seal, splice, and tee kit components shall be applied in the field.

G. Heating cable circuit shall be protected by a ground-fault device for equipment protection in accordance with section 427-22 of the NEC 2005.

H. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. All components that make an electrical connection shall be accessible for servicing. No component shall use silicone to seal the electrical connections.

I. The system shall be controlled by an ambient sensing line voltage thermostat with integral or separately mounted disconnect switch.

J. Provide all necessary or required components and accessories, such as power connection boxes, end seals, straps, tape and fitting brackets.

K. Provide insulation as shown on the drawing.

PART 3 – EXECUTION

3.1 PREPARATION

A. Install materials after piping has been tested and approved.

3.2 INSTALLATION

A. Apply the heating cable linearly on the pipe secured with cable ties or fiberglass tape.

B. Apply "Electric Traced" labels to the outside of the thermal insulation.

C. Heat trace systems shall each be single zone with one thermostat not to exceed manufacturer's recommended maximum length.

D. Heat trace shall be installed to maintain a minimum pipe temperature of 60°F.

3.3 TESTS

A. After installation and before and after installing the thermal insulation, subject heating cable to testing using a 2500-Vdc Megger. Minimum insulation resistance shall be 20 μm or greater.

END OF SECTION

SECTION 17000

CONTROL AND INFORMATION SYSTEM SCOPE AND GENERAL REQUIREMENTS

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SECTION 17000

CONTROL AND INFORMATION SYSTEM SCOPE AND GENERAL REQUIREMENTS

PART 1 — GENERAL

1.1 SCOPE

A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.

B. The scope of the work to be performed under this Division includes but is not limited to the following:

1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.
2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the drawings and as specified in Division 17.
4. Furnish and install digital control system hardware and software as specified in Division 17. Personal computer hardware, associated operating system software, and printers shall be provided by the Contractor.
5. Final termination and testing of all instrumentation and control system signal wiring and power supply wiring at equipment furnished under Division 17.
6. Furnish, install and terminate all special cables (instruments, printers, telemetry, etc.) and operator workstation network cables; and furnish and terminate data highway network cables.
7. Furnish and install transient voltage surge suppression systems for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 16.
8. Coordinate grounding requirements with the electrical subcontractor for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division. Terminate grounding system cables at all equipment provided under this Division.
9. Provide system testing, calibration, training and startup services as specified herein and as required to make all systems fully operational.

C. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.2 RELATED ITEMS

A. Field mounted switches, torque switches, limit switches, valve and gate operator position transmitters, sump pump controls and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested and calibrated as specified under other Divisions.

B. Additional and related work performed under Division 16 includes the following:

1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for all equipment, control panels and accessories furnished under Division 17.
2. Conduit and raceways for all instrumentation and control system signal wiring, grounding systems, special cables and data highway cables.
3. Instrumentation and control system signal wiring.
4. Install data highway network cables.
5. Furnish and install grounding systems for all digital equipment, local control panels, and instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17, ready for termination by the instrumentation subcontractor.
6. Termination of all instrumentation and control system signal wiring at all equipment furnished under other divisions of the Specifications.
7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g. panelboards, motor control centers, and other sources of electrical power).

1.3 GENERAL INFORMATION AND DESCRIPTION

A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

B. In order to centralize responsibility, it is required that all equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating all signals, and furnishing all appurtenant equipment.

C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of all detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment and/or systems and shall provide for the services of a qualified installation engineer to supervise all activities required to place the completed facility in stable operation under full digital control.

D. The instrumentation and control system shall be capable of simultaneously implementing all real-time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of any system component. It shall also be possible to simultaneously generate displays on all workstations and print out data on all printers without degradation of system performance.

E. Control system inputs and outputs are listed in the Input/Output Schedule. This information, together with the control strategy descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real-time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.

F. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field-mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect all equipment, panels, instrumentation, controls and appurtenances either existing or furnished under other Divisions of the Specifications to determine all requirements to interface same with the

control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.

G. The instrumentation subcontractor shall review and approve the size and routing of all instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.

H. The Contractor shall coordinate the efforts of each supplier to aid in interfacing all systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.

I. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.

J. The Owner shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies and services required for these surveillance activities.

K. The terms "Instrumentation", "Instrumentation and Control System", "Instrumentation, Control and Information System", and "SCADA System" shall hereinafter be defined as all equipment, labor, services and documents necessary to meet the intent of the Specifications.

1.4 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment facilities. Instrumentation and control system subcontractors shall have a minimum of five years of such experience, and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers and/or models of major hardware or software products (PLC, HMI software, LAN, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least one project using that specified hardware or software. As used herein, the term "completed" shall mean that a project has been brought to final completion and final payment has been made. Any instrumentation and control system subcontractor that has been subject to litigation or the assessment of liquidated damages for nonperformance on any project within the last five calendar years shall not be acceptable.

1.5 DEFINITIONS

A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.

B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.

D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

A = 100 x (MTBF/(MTBF + MTTR)) Percent

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

A = A2 + 1 - ((1-A1) x (1-A1))

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

A	-	Availability
ADC	-	Analog to Digital Converter
AI	-	Analog Input
AO	-	Analog Output
AVAIL	-	Available
BCD	-	Binary Coded Decimal
CSMA/CD	-	Carrier Sense Multiple Access/Collision Detect
CPU	-	Central Processing Unit
CRC	-	Cyclic Redundancy Check
CRT	-	Cathode Ray Tube
CS	-	Control Strategy
DAC	-	Digital to Analog Converter
DBMS	-	Data Base Management System
DI	-	Discrete Input
DMA	-	Direct Memory Access
DO	-	Discrete Output
DPDT	-	Double Pole, Double Throw
DVE	-	Digital to Video Electronics
EPROM	-	Erasable, Programmable Read Only Memory
FDM	-	Frequency Division Multiplexing
FSK	-	Frequency Shift Keyed

HMI	-	Human Machine Interface (Software)
I/O	-	Input/Output
LAN	-	Local Area Network
LDFW	-	Lead-Follow
MCC	-	Motor Control Center
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time To Repair
OIC	-	Operator Interface Computer
OIP	-	Operator Interface Panel (for PLCs)
OS	-	Operating System
PCB	-	Printed Circuit Board
PID	-	Proportional Integral and Derivative Control
PLC	-	Programmable Logic Controller
PROM	-	Programmable Read Only Memory
RAM	-	Random Access Memory
RDY	-	Ready
RMSS	-	Root Mean Square Summation
RNG	-	Running
ROM	-	Read Only Memory
RTU	-	Remote Telemetry Unit
SPDT	-	Single Pole, Double Throw
ST/SP	-	Start/Stop
TDM	-	Time Division Multiplexing
UPS	-	Uninterruptible Power Supply

H. To minimize the number of characters in words used in textual descriptions on CRT displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.6 ENVIRONMENTAL CONDITIONS

A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.

B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., for dust).

C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.

D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets and interconnecting hardware shall be aluminum or 316 stainless steel as shown on the installation detail drawings.

PART 2 – PRODUCTS

2.1 NAMEPLATES

A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.

C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

PART 3 – EXECUTION

3.1 SCHEDULE OF PAYMENT

A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer payment for the Control and Information System as outlined below.

B. The following payment schedule defines project milestones that will be used for establishing maximum partial payment amounts for the Control and Information System. Payment for field instruments, field wiring, fiber optic network cable and similar items will be made in addition to the payment for the scopes of services incorporated into the schedule below.

Task Completed	Maximum Cumulative % Request for Payment
Mobilization	3%
Preliminary Design Review	5%
Approved Submittals	20%
Hardware Purchase (excludes field instruments)	40%
Factory Acceptance Test	60%
Loop Checkout	70%
Control System Start-up and Test	80%
Plant Start-up	90%
Final System Acceptance Test	95%
Final Acceptance	100%

C. Requests for payment for materials and equipment that are not installed on site, but are required for system construction and the factory acceptance test (e.g., digital hardware), or are properly stored as described in the General and Supplementary Conditions and herein, shall be accompanied by invoices from the original supplier to the instrumentation subcontractor substantiating the cost of the materials or equipment.

D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials for which payment is made by invoice, will be considered due upon completion of the Final Acceptance test.

3.2 CLEANING

A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.

B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.3 FINAL ACCEPTANCE

A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:
   1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.
   2. Completion of the Availability Demonstration
   3. Completion of all punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the extended warranty period.

END OF SECTION

SECTION 17015

PRELIMINARY DESIGN REVIEW

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SECTION 17015

PRELIMINARY DESIGN REVIEW

1.1 THE REQUIREMENT

A. The Contractor shall conduct a preliminary design review meeting for Owner personnel and the Engineer to ensure design compliance with all hardware and software requirements in the Contract Documents. Other supplemental design review meetings may be held as required by the Engineer or the Owner to resolve specific problems, to provide positive assurance to the Owner that the design conforms to contractual requirements, or to allow for concurrent planning activities by the Owner that are dependent upon the as-built system configuration/operation.

B. The Preliminary Design Review shall, at the discretion of the Owner, be conducted at the Owner's facility, the Contractor's facility, or at a location suggested by the Owner.

C. The Preliminary Design Review shall be conducted no later than 90 days after notice to proceed.

1.2 PRELIMINARY DESIGN REVIEW

A. The Preliminary Design Review (PDR) shall be a formal meeting to review the overall system design with emphasis being placed upon the arrangement and interactive operation of all items of digital equipment.

B. While the Preliminary Design Review is a meeting rather than a submittal, to the greatest extent possible all data to be presented at the PDR shall be furnished to the Owner two (2) weeks prior to the meeting date. Data made available by the Contractor shall include, but not be limited to the following:

1. Overall system block diagram(s), and preliminary digital hardware placement, preliminary console and equipment panel arrangements and layouts.
2. A brief functional description of the block diagram(s) shall be provided. The functional description shall describe the overall system operation, interaction between system elements, fail-over procedures and system/operator interactions.
3. A listing of the manufacturer's name and model number for each item of hardware shown in the block diagram(s), all analog instruments and auxiliary equipment such as power supplies.
4. The following software information:
   a. Brief overall description of software design and organization.
   b. List and description of all system software.
   c. List and description of all process control system software.
5. Brief description of the intended plan for implementing system development, assembly, checkout, hardware/software performance verification, installation, activation and factory test activities.
6. Identification of critical engineering activities and long lead-time procurement items.
7. Preliminary construction schedule, including submittal dates.
8. A copy of the proposed System Maintenance Contract.
9. Resumes listing qualifications of process control system engineering and technical personnel (including field installation personnel) expected to be assigned to the project, together with an estimate of the percentage of time such personnel are expected to devote to the project.

PART 2 – PRODUCTS - NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 17030

CONTROL AND INFORMATION SYSTEM SUBMITTALS

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SECTION 17030

CONTROL AND INFORMATION SYSTEM SUBMITTALS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - *Submittals.*

B. Section 17000 - *Control and Information System Scope and General Requirements.*

1.3 DIGITAL HARDWARE SUBMITTALS

A. Submit system block diagram(s) showing:
   1. All equipment to be provided.
   2. All interconnecting cable.
   3. Equipment names, manufacturer, and model numbers.
   4. Equipment locations.

B. Submit information for all digital equipment including, but not limited to, the following:
   1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
   2. Catalog cuts.
   3. Complete technical, material and environmental specifications.
   4. Assembly drawings.
   5. Mounting requirements.
   6. Color samples.
   7. Nameplates.
   8. Environmental requirements during storage and operation.

1.4 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:
   1. Bill of materials with software names, vendors, and complete listings of included software modules.
   2. Standard manufacturer's literature describing the products.
   3. Description of function of software in Control and Information System.
   4. Limitations or constraints of software.
   5. Minimum system (processor and memory) requirements.
   6. Operation and maintenance requirements.

B. Submit information on the following software:
   1. Third-party software, including:
      a. Operating system.
      b. Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.).
      c. Control software (block oriented and/or ladder logic).
      d. Office-type products, such as spreadsheets, word processors, etc.
      e. Database management software.

f. Communications software, including all applicable local and wide area network software.
g. Programmable logic controller programming software (where applicable).

2. Software configuration, including:
   a. Graphic display organization.
   b. Database configuration for operator workstations and database management system.
   c. Trends.
   d. System security.
   e. Formats for all reports, including all required calculations.
   f. Intercommunications between software products required to implement system functions.
   g. Equipment backup configuration and requirements.

C. Control Strategies:

1. Provide control strategy documentation that includes control strategy diagrams (either block oriented logic or ladder logic diagrams, as appropriate) to describe the control of all processes. The written description shall follow the format of the functional control descriptions contained herein. The control strategy submittals shall contain the following as a minimum:
   a. An overall description of the program structure and how it will meet the specified control requirements.
   b. A listing of the program.
   c. Extensive comments in the listings to describe program steps.
   d. Equation and ladder program derivations for all specified control routines.
   e. Resource (processor and memory) requirements.
   f. A listing of inputs and outputs to the control strategy.

D. Application Software:

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include VBASIC and C programs, and any other add-in custom software.

E. Graphic Displays:

1. Submit all graphic displays required to perform the control and operator interface functions specified herein.
2. Submit graphic displays for review by the Owner and the Engineer at least 60 days prior to commencement of factory testing.
3. The Contractor shall allow for one major cycle of revisions to the displays prior to factory testing and one minor cycle of revisions following factory test.. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.
4. Two of the required submittals in each revision cycle shall be full color prints of the entire set of displays. Additional sets may be in black-and-white or gray-scale.
5. Displays shall be printouts of actual process graphics implemented in the system.

1.5 CONTROL PANEL SUBMITTALS

A. Submittals shall be provided for all control panels, and shall include:

1. Exterior panel drawings with front and side views, to scale.
2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.
3. Panel area reserved for cable access and conduit entry.
4. Location plans showing each panel in its assigned location.

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
2. Catalog cuts.
3. Complete technical, material and environmental specifications.
4. Assembly drawings.
5. Mounting requirements.
6. Color samples.
7. Nameplates.
8. Environmental requirements during storage and operation.

C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

1.6 INSTRUMENT SUBMITTALS

A. Submit information on all field instruments, including but not limited to the following:

1. Product (item) name and tag number used herein and on the Contract Drawings.
2. Catalog cuts.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations.
7. Physical size with dimensions, NEMA enclosure classification and mounting details.
8. Materials of construction of all enclosures, wetted parts and major components.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data on all flow metering devices.
11. Environmental requirements during storage and operation.
12. Associated surge protection devices.

1.7 WIRING AND LOOP DIAGRAMS

A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.

B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.

C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items.

1.8 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01300 - Submittals. Operation and maintenance (O&M) manuals shall consist of two basic parts:

1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.
2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.

B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the

drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.

1. A comprehensive index.
2. A functional description of the entire system, with references to drawings and instructions.
3. A complete "as-built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.
4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
5. Full specifications on each item.
6. Detailed service, maintenance, and operation instructions for each item supplied.
7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.
9. References to manufacturers' standard literature where applicable.
10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.

D. The operating instructions shall clearly describe the step-by-step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.

E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.

F. The hardware maintenance documentation shall include, as a minimum, the following information:

1. 1. Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
2. 2. Preventive-Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.
3. 3. Corrective-Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
4. 4. Parts Information - This information shall include the identification of each replaceable or field-repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any

repairable or replaceable part. Cross-references between equipment numbers and manufacturer's part numbers shall be provided.

G. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:

1. A program abstract that includes:
   a. Program Name - The symbolic alphanumeric program name.
   b. Program Title - English text identification.
   c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by nonsoftware oriented readers.
2. A program description that shall include, but not be limited to, the following:
   a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.
   b. Input-Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.
   c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.
   d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.
   e. Limitation and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.
   f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.
   g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.
   h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.
   i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.9 FINAL SYSTEM DOCUMENTATION

A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.

B. If any documentation or other technical information submitted is considered proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

C. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected so as to describe final "as-built"

hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

D. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as-built software configurations.

E. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

F. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.

G. O&M documentation shall be amended with the final, adjusted values for all setpoints and other operating parameters for Owner reference.

H. The Owner recognizes the fact that not all possible problems related to real-time events, software interlocks, flags, active tasks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.10 PROGRAMS AND SOURCE LISTINGS

A. Provide two copies of all standard, of-the-shelf system and application software (exclusive of firmware resident software) on tape or disk. One copy shall be the original tapes or disks from the manufacturer, with one additional copy for backup purposes.

B. Provide two copies of source listings on tape or disk for all custom software written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

1.11 SUBMITTAL/DOCUMENTATION FORMAT

A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.

B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word.

1.12 ELECTRONIC O&M MANUALS

A. At least one complete volume of all required O&M information shall be submitted in an electronic format on optical media. However, at least one hardcopy version shall also be provided.

B. Electronic O&M manuals shall contain information in standard formats (Adobe, Word, AutoCAD, HTML, etc.) and shall be easily accessible through the use of standard, "off-the-shelf" software such as an Internet browser.

1 PART 2 – PRODUCTS - NOT USED

2 PART 3 – EXECUTION - NOT USED

3 END OF SECTION

SECTION 17040

CONTROL AND INFORMATION SYSTEM TRAINING REQUIREMENTS

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SECTION 17040

CONTROL AND INFORMATION SYSTEM TRAINING REQUIREMENTS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. To familiarize the Owner's personnel with the process control system and field instrumentation, training shall be provided as detailed hereunder.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

1.3 SUBMITTALS

A. A minimum of 60 days prior to beginning training, submit a detailed training plan describing the following:
   1. A listing of all courses to be conducted.
   2. Course content.
   3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.
   4. Course schedules.
   5. Qualifications and experience of individual(s) providing training.

B. A minimum of 14 days prior to beginning each training course, submit documentation for use by the Owner's personnel during training. The training documentation shall be specific to the particular course, and shall include the following:
   1. A listing of all subjects to be covered.
   2. Course schedule.
   3. Documentation/lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format, with sufficient background documentation and references to manufacturer literature to provide a thorough and clear understanding of the materials to be covered.

1.4 GENERAL REQUIREMENTS

A. All costs of providing the training courses shall be borne by the Contractor.

B. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five-day, 40-hour week.

C. All training courses shall complement the experience and skill levels of the Owner's personnel.

D. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.

E. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The Contractor shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the Owner's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.

F. Unless otherwise specified, all training courses shall be conducted in the Owner's facilities.

G. All training shall be completed prior to system acceptance.

H. Standard manufacturer training courses are acceptable pending approval by the Engineer and Owner.

1.5 SYSTEM SUPERVISOR/ENGINEER TRAINING

A. Provide manufacturer standard training in the use and configuration of the specified operator workstation (SCADA) software.

B. System supervisor/engineer training shall be performed a minimum of 30 days prior to system startup. Total training duration shall be a minimum of five days.

C. Training shall be provided in the following subjects:
   1. System overview and capabilities.
   2. Database configuration.
   3. Graphic display configuration, including linking of data to displays.
   4. Historical data configuration (collection, manipulation, and display).
   5. Real-time and historical trending.
   6. Report configuration, generation, printing, and customization.
   7. Alarm configuration and management.
   8. System security.
   9. I/O driver use and configuration.
   10. System backup and recovery.
   11. DDE linking, where applicable.
   12. System command language.
   13. Troubleshooting.
   14. System optimization.
   15. System startup and shutdown procedures.
   16. LAN and WAN communications, as appropriate.

D. The course shall be structured as follows:
   1. Fundamentals - One two-day course (minimum) shall be provided for up to eight persons which shall serve as a digital control system familiarization course for project management personnel, engineers, and key operating/maintenance personnel. This course shall be a prerequisite for the advanced course described below in Item 2.
   2. Advanced - One three-day (minimum) digital system configuration and operating course shall be provided for up to four persons. The level of training shall be sufficient to familiarize the Owner's personnel with the configuration and application of all system programs. All essential system operating procedures shall be described as required to enable the Owner's personnel to operate the system via the various workstations and local control panels.
   3. Historical - One two-day course to instruct a minimum of four persons in the use and configuration of the historical data archival system. Training shall include creation, viewing, and printing of trends, charts, and reports. Training shall include all database maintenance and archival functions necessary to maintain the facility's data on both short and long term basis, including periodic archival to optical media.

1.6 OPERATOR TRAINING

A. Two two-week courses comprised of daily half-day (four-hour) sessions for up to ten persons each shall be conducted to provide instruction in the use of the Control and Information System to monitor and control the facility.

B. Operator training shall include familiarization training covering the Control and Information System. Operators shall be instructed in the names, locations, functions, and basic operation of all items of digital equipment and associated software.

C. Operator training shall cover process and equipment operation both individually and collectively as an operating system. Normal as well as abnormal operating conditions shall be covered, including the response to failure occurrences and system alarms. All operator/system interactions shall be described.

D. Operators shall be trained to instruct other operators and shall be provided with all course materials.

1.7 MAINTENANCE TRAINING

A. A three-day course shall be conducted for at least six persons prior to the start-up of digital equipment at the Owner's plant. Instruction shall be provided in the following:

1. Operating all digital equipment, including system start-up and shutdown procedures.
2. The use of hardware diagnostic routines, test equipment and test procedures as required to enable the Owner's personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules.
3. Calibration and routine maintenance procedures for all analog and digital equipment.

B. Step by step written procedures shall be provided for all preventive maintenance tasks and for identifying hardware faults to the circuit board or module level for all items of digital equipment.

C. All digital equipment preventive and corrective maintenance training activities shall be limited to the use of commercially available off-the-shelf test equipment and to the use of diagnostic routines and hardware items which are the same as those to be provided as part of the system.

1.8 INSTRUMENT TRAINING

A. A three-day course shall be provided at the Owner's facilities no more than three months prior to system start-up to instruct a minimum of five persons each in the calibration and preventive maintenance of the field instruments provided under this Contract.

1.9 PLC TRAINING

A. One three-day manufacturer standard training course shall be provided in the programming and use of PLC's to implement monitoring and control functions such as those provided for this project. Training shall cover all aspects of the PLC hardware and software, including specified programming software.

B. One three-day course of specific training shall be provided by the instrumentation subcontractor in the use and modification of all control strategies provided under this Division.

1.10 GENERAL REFRESHER TRAINING

A. A one-week general refresher training course shall be provided for up to ten persons 3-6 months after final system acceptance. Instruction shall be given in all aspects of the complete instrumentation and control system. Instructor(s) shall be capable of answering questions related to all aspects and details of the complete system.

1.11 PROPOSED TRAINING AGREEMENT

A. The instrumentation subcontractor shall submit a proposed training agreement to extend the training services described above for a period of up to five years from the expiration of the guarantee period. The proposed agreement shall include provisions for payment on a cost plus expenses basis and re-negotiation of contract prices based upon changes in recognized economic indicators published by the United States Department of Commerce.

PART 2 – PRODUCTS - NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 17060

SIGNAL COORDINATION REQUIREMENTS

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SECTION 17060

SIGNAL COORDINATION REQUIREMENTS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall conform to the signal coordination requirements specified herein.

B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, the HVAC subcontractor, and the instrumentation subcontractor.

C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLC's and Control System PLC's.

D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLC's, the Control System, etc.

1.2 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 volts D.C.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.

E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliampere signal.

F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.

H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.3 DISCRETE INPUTS

A. All discrete inputs to equipment and Control and Information System PLC's, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC's, unless specified otherwise.

B. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC.

1.4 DISCRETE OUTPUTS

A. All discrete outputs from local control panels and Control and Information System PLC's to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLCs.

B. PLC powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.

C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLCs to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.

D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

1.5 OTHER DISCRETE SIGNALS

A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.

B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.

C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.

D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 – PRODUCTS

2.1 PILOT RELAYS

A. Pilot relays shall be supplied with the following:
   1. 24 VDC coils.
   2. At a minimum, DPDT contacts rated at 5 A, 120 VAC or 28 VDC.
   3. Socket of different configuration from 120 VAC relays.
   4. Clips for attachment to sockets.
   5. Indicator lights that glow when the relay coil is powered.

B. Pilot relays shall be as manufactured by Square D, Allen Bradley, Potter & Brumfield, or equal.

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 17070

CONTROL AND INFORMATION SYSTEM TESTING - GENERAL

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SECTION 17070

CONTROL AND INFORMATION SYSTEM TESTING - GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17071 - *Factory Acceptance Test.*

C. Section 17072 - *Field Testing.*

D. Section 17073 - *Final Acceptance Test.*

1.3 SUBMITTALS

A. For each of the specified tests, submit a test plan to the Engineer at least one month in advance of commencement of the tests. The test plan shall contain the following at a minimum:

1. A schedule of all testing to be conducted.
2. A brief description of the testing to be performed
3. Test objectives.
4. Testing criteria per the Specifications.
5. Check lists and procedures for performing each of the specified tests.
6. Sample test result documentation.
7. Requirements for other parties.

1.4 GENERAL REQUIREMENTS

A. All system start-up and test activities shall follow detailed test procedures, check lists, etc., previously approved by the Engineer. The Engineer shall be notified at least 21 days in advance of any system tests and reserves the right to have his and/or the Owner's representatives in attendance.

B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

C. The Contractor (or designee) shall maintain master logbooks for <u>each</u> phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.

D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.

E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

PART 2 – PRODUCTS - NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 17072

FIELD TESTING

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SECTION 17072

FIELD TESTING

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17070 - *Control and Information System Testing, General.*

C. Section 17071 - *Factory Acceptance Test.*

D. Section 17073 - *Final Acceptance Test.*

1.3 GENERAL REQUIREMENTS

A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:

1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Sections 17600, 17700, and 17800.
2. Each final control element shall be individually tested as specified hereinafter.
3. Each control loop shall be tested as specified hereinafter.
4. Each control strategy shall be tested under automatic digital control as specified hereinafter.
5. The entire control system shall be tested for overall monitoring, control, communications, and information management functions, and demonstrated for system availability as specified hereinafter.

B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.

C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.

C. The Contractor shall ensure that the electrical subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete

and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.

D. The Contractor shall ensure that the HVAC subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function of all HVAC system control and interlock circuitry and the transmission of all discrete and/or analog signals between HVAC equipment and controls and the control system specified herein.

1.5 FINAL CONTROL ELEMENT TESTING

A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFD's, that require turndown limits shall be initially set during this test.

C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

1.6 LOOP CHECKOUT

A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all DAC's shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.

D. The accuracy of all ADC's shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.

E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.7 CONTROL SYSTEM STARTUP AND TESTING

A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.

C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.

D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.

E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.

F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.

H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.8 FACILITY STARTUP COORDINATION

A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.

B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.

D. At least one qualified control systems technician shall be provided for control system startup and test activities (at least two when loop checkout is being performed).

PART 2 – PRODUCTS - NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 17100

CONTROL AND INFORMATION SYSTEM HARDWARE - GENERAL

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SECTION 17100

CONTROL AND INFORMATION SYSTEM HARDWARE - GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The process control system is physically and functionally distributed between PLC equipped control panels, motor control panels, field panels, operator workstations and appurtenances.

B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance and local monitoring purposes only and shall not be regarded as backup to the PLC based control system.

C. Major plant control system digital equipment items are shown on the Control System Block Diagram in the Contract Drawings and are specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17120 - *Programmable Logic Controllers.*

B. Section 17140 - *Operator Workstations.*

C. Section 17180 - *Local Area Network.*

1.3 DIGITAL HARDWARE CONFIGURATIONS

A. The digital hardware configuration shown on the Control System Block Diagram depicts overall system configuration requirements. System design shall be based upon this concept and shall provide an overall digital system availability of 99.8 percent under the conditions specified in Section 17073. Unless otherwise specified, designs that vary from this concept will be rejected.

B. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. Operator workstations shall be fully independent devices, individually connected to the data highway local area network.

C. One fiber optic local area network (data highway network) shall be employed for communications among the programmable logic controllers and the operator workstations designated as SCADA servers. A separate local area network shall be employed for communications among the client and server operator workstations to support inter-workstation communications and data transfer functions.

D. No other exceptions will be considered.

PART 2 – PRODUCTS

2.1 GENERAL SYSTEM HARDWARE REQUIREMENTS

A. Large scale integrated (LSI) circuit construction shall be employed unless otherwise specified.

B. Modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCB's or modules shall be employed for easy removal to permit exposure of circuit wiring, components and test points. Extender boards shall be provided if necessary to permit PCB's to be completely exposed for testing purposes.

C. Keying schemes shall be used to prevent PCB misplacement.

D. Each process control system local area network connected device shall continuously perform on-line diagnostics and failure reporting to the operator workstations.

E. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.

2.2 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS

A. No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed up system component is undergoing preventive or corrective maintenance.

B. All devices connected to the data highway local area network shall be self-checking and shall report their operational status to the operator workstations as whether "normal" or "failed".

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17000, Part 3.

END OF SECTION

SECTION 17120

PROGRAMMABLE LOGIC CONTROLLERS

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SECTION 17120

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all programmable logic controllers, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17060 - *Signal Coordination Requirements.*

C. Section 17100 - *Control and Information System Hardware - General.*

D. Section 17125 - *PLC Operator Interface Units.*

E. Section 17180 - *Local Area Network.*

F. Section 17190 - *Uninterruptible Power Systems.*

G. Section 17500 - *Enclosures - General.*

1.3 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One of each type of CPU and co-processor module for PLC equipment furnished under this Contract.
2. One of each type of input/output module for PLC equipment furnished under this Contract.
3. One of each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 – PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

A. The instrumentation subcontractor shall furnish programmable controllers (PLC's) as specified herein and as shown on the Drawings. PLC's shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. PLC I/O cards may be supplied by third party vendors if approved by the PLC manufacturer and the Engineer. No substitutions will be permitted.

B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

C. Programmable controllers shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0□-60□□ and a relative humidity of 5-95

percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

D. The minimum PLC rack size for rack-based PLCs shall be 7 slots, not to include main processor or power supply slots.

E. System configuration shall be as shown on the Control System Block Diagram. PLC types shall be designated on the Control System Block Diagram and correspond to the specifications herein. Only a single type of processor shall be supplied for all PLC's of a designated type. Memory and processor shall be adequate for all control functions specified. PLC's shall be as manufactured or equal to those listed in the following table.

PLC Type:	Minimum PLC to be provided
Mid-Size:	GE Fanuc 90-30 with CPU374 processor
	Allen-Bradley SLC500 with SLC-5/05 processor
	Modicon 984-120 Compact with PC-E984-285 processor
Small:	GE Fanuc 90-30 with CPU352 processor
	Allen-Bradley MicroLogix 1200 processor
	Modicon Momentum processor

2.2 PROCESSORS

A. The processor and its associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or equivalent shall be used to select processor operating mode. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Memory shall consist of battery-backed RAM that shall retain the control program indefinitely as long as AC power is supplied. Lithium batteries shall maintain processor RAM memory for at least one year in the event of power loss. Visual indication shall be provided if battery charge is insufficient to maintain the program in RAM memory for at least two weeks.

B. The ladder logic instruction set for the PLC shall include the following, as a minimum:
   1. Relay type instructions
   2. Counter and timer instructions
   3. Comparison instructions (equal, greater than, limit tests, etc.)
   4. Integer and floating point mathematical instructions
   5. Advanced math and trigonometric functions
   6. Statistical instructions
   7. Matrix and array instructions
   8. Logical instructions (and, not, or, etc.)
   9. BCD conversion instructions
   10. Bit modification, moving, and shift instructions
   11. File instructions (search, copy, fill, etc.)
   12. Diagnostic instructions
   13. Sequencer instructions
   14. Program control instructions (jump, goto, subroutine, etc.)
   15. PID control loops
   16. Block read and write capability
   17. Send/receive messages
   18. Immediate I/O and communications update instructions

C. Additional co-processors or modules may be required to meet the minimum instruction set.

2.3 COMMUNICATIONS

A. PLC communications shall be provided as specified in Section 17180 - Local Area Network and as shown on the Control System Block Diagram.

B. In addition to a communications port for the data highway network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

2.4 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules in associated I/O rack or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC or 120 VAC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 17060 - Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 17550. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 12-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15□□ and be capable of accepting signals from 100-ohm Platinum RTD's. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 17560 - Transient Voltage Surge Suppression Devices. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode, or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

2.5 REMOTE I/O SUBSYSTEMS

A. Remote I/O shall be provided as designated on the Control System Block Diagram. Remote I/O shall be either PLC rack type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Subsection 2.04, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.

B. Remote I/O shall communicate with the PLC using the PLC manufacturer's standard protocol or an open standard network such as DeviceNet, Ethernet IP, Profibus, Foundation Fieldbus, Modbus, or equal.

2.6 INPUT/OUTPUT CIRCUIT ARRANGEMENT

A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

2.7 PROGRAMMING SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest version, Windows-based. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. Programming shall be accomplished through the use of ladder logic and other IEC 1131.3 languages. PLC programming software shall include CD-ROM documentation.

B. Third-party programming software shall be acceptable if recommended by the manufacturer and if that software exceeds the capabilities of the PLC manufacturer's standard software package.

C. All configuration and programming software necessary shall be provided on a portable notebook computer for connection to the PLC processor via a communications port. The notebook computer will be purchased under a hardware allowance as specified herein. All necessary hardware required to allow the notebook computer to perform PLC configuration and programming shall be provided.

D. If available, the configuration and programming software shall support communication over the network specified in Section 17180 - Local Area Network to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the SCADA Server operator workstations shown on the control system block diagram. All necessary hardware required to have the operator workstation perform PLC configuration and programming shall be provided.

PART 3 — EXECUTION

3.1 REQUIREMENTS FOR MANUFACTURER-SUPPLIED PLCS

A. PLCs that are supplied for equipment local control panels by individual equipment manufacturers or suppliers shall, where so indicated on the Control System Block Diagram, be integrated into the plant control system. The manufacturer-supplied PLC shall be furnished, installed and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the main control system at the plant.

B. Where required as described above, each manufacturer-supplied PLC shall be connected to the Ethernet data highway network for access from the plant control system SCADA servers, as specified in Section 17185, and shall contain a fiber optic Ethernet switch identical to those provided for the rest of the data-highway-connected PLCs. Each equipment manufacturer shall provide all monitoring and control data to be transferred between the PLC and the plant control system in contiguous blocks of PLC registers to facilitate block read and write commands for efficient scanning by the control system SCADA servers. These contiguous registers shall be arranged in a single data transfer area, which shall be divided into eight distinct areas with an emphasis on flexibility and future expansion. The distinct areas shall be arranged by data type (analog or discrete), transfer direction (server to PLC or PLC to server), and, where applicable, implementation schedule (current or future). Where required, peer-to-peer communication between PLCs shall likewise be accomplished using separate blocks of contiguous registers. Where individual equipment PLCs are not required to be connected to the plant control system via the data highway network, they shall provide the individual hardwired signals as specified in the Contract Documents. Data and commands for connection to the control system are described in the P&I Drawings, the Input/Output Schedule, the individual equipment specification sections, and in Section 17950 - Functional Control Descriptions.

C. The operator interface for control of each individual system shall be performed by local operator interface units as specified in Section 17125 or individual pilot devices on the equipment local control panel, as specified in the associated equipment specification section. Additional operator interface functions shall be provided through the plant control system as specified in the respective equipment specifications and in Section 17950.

D. Where operator interface and control functions are required to be provided through the plant control system, the individual system supplier shall be responsible for coordination with the instrumentation subcontractor to provide a complete and working equipment control system. The individual equipment supplier shall also be responsible for limiting the access of the plant control system to the equipment PLC code so as to prevent malfunctions of the equipment and any failure to continuously perform its intended functions. The equipment supplier shall also provide direction in the configuration of the SCADA software's security system by the instrumentation subcontractor to limit access to the control functions of the equipment control system to authorized personnel only. The equipment supplier shall coordinate testing of the completed system with the instrumentation subcontractor, which shall conform to the requirements of Section 17072 - Field Testing.

E. The Contractor, equipment supplier and instrumentation subcontractor shall coordinate testing and startup of the equipment provided by the equipment supplier with the plant control system, including but not limited to the following tasks:

1. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.
2. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the instrumentation subcontractor and equipment manufacturer personnel to perform loop checks simultaneously, as directed by the Engineer.
3. Coordinate and assist as needed to maintain I/O connectivity throughout the system.
4. Ensure personnel safety while equipment is exercised via the plant control system.
5. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the plant control system.
6. Provide temporary modifications to field devices and their terminations, if needed.
7. Providing labor and supervision which may include, but is not limited to: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about the process startup and operation.
8. Operation of process equipment for verification of each plant control system input and output.

3.2 REQUIREMENTS

A. Refer to Section 17000, Part 3.

END OF SECTION

SECTION 17125

PLC OPERATOR INTERFACE UNITS

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SECTION 17125

PLC OPERATOR INTERFACE UNITS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all operator interface units, with all spare parts, accessories, and appurtenances in all PLC cabinets as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17100 - *Digital System Hardware Configuration.*

C. Section 17120 - *Programmable Logic Controllers.*

PART 2 – PRODUCTS

2.1 OPERATOR INTERFACE UNIT - MONOCHROME TOUCH SCREEN

A. An Operator Interface Unit (OIU) shall be provided to view PLC parameters and to display alarm messages using a graphical user interface. The OIU shall provide the following features as a minimum.

1. Minimum of 6 inch diagonal display
2. Monochrome LCD Display of 256 X 128 pixels
3. Resistive film touch screen interface
4. Minimum of 240K Flash application memory
5. Minimum of 170K Application Runtime memory
6. Real time Clock with battery backup
7. Minimum 128 touch cells
8. RS-232 Printer port
9. Operating Voltage: 24 VDC (internal or via independent power supply)
10. Enclosure Rating: NEMA 12/4X to match the associated PLC cabinet rating
11. Environment: 0-55□C, 5-95% relative humidity, non-condensing

B. The operator interface unit shall be Allen-Bradley PanelView 550, GE Fanuc QuickPanel View Intermediate or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. The OIU shall be configured to display all PLC I/O, set points, and parameters. All equipment failures shall be alarmed. PLC I/O values and operator-entered set points shall be displayed with associated units and service descriptions. Menus shall be provided to navigate between screens of different equipment items. Displays shall be arranged in a hierarchical structure with displays for specific equipment items grouped together. Additional functionality shall be as specified elsewhere in this Division.

B. All necessary configuration and programming software shall be provided on CD media and turned over to the Owner.

C. Refer to Section 17000 for additional requirements.

END OF SECTION

SECTION 17180

LOCAL AREA NETWORK

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SECTION 17180

LOCAL AREA NETWORK

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation IEEE 802.3 Ethernet local area networks for communications among operator workstations, among PLCs, and between the PLCs and main SCADA servers, as shown on the Drawings.

B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17100 - *Digital System Hardware Configuration.*

1.3 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools and Supplies. In addition, the following specific spare parts items shall be provided:

1. A termination tool kit shall be provided containing all required tools and consumables for up to 25 connections of each connection type furnished. Termination kit shall be as manufactured by Black Box, Corning Cable Systems, or equal.

PART 2 — PRODUCTS

2.1 AREA NETWORK (LAN)

A. An IEEE 802.3 Ethernet local area network shall be used for communications among operator workstations and PLCs.

B. Network configuration shall be as shown on the Control System Block Diagram in the Contract Drawings. Network wiring shall be unshielded-twisted pair cables for 10-BaseT configuration within the buildings. Fiber optic media shall be used for PLC communication and for all inter-workstation communication links extending outside of a building, unless specifically noted on the Control System Block Diagram.

C. The Contractor may provide a network configuration different from that shown in the Contract Drawing with written approval of the Engineer, but the Contractor shall coordinate with all affected trades and pay for all additional charges incurred.

D. The local area network shall meet the following requirements:

1. The minimum data transmission speed shall be 10 Mbps.
2. The network-connected devices shall equally share access to the network. Devices shall be normally passive (listen) with respect to the network.
3. A separate controller "traffic director", or other network connected device used to maintain traffic control between devices is not acceptable.
4. The network shall utilize the TCP/IP communications protocol.
5. Networks employing master/slave or similar communications protocols shall be rejected.
6. An error detection check shall be made on each data word that is transmitted on the network, consisting of a cyclic redundancy check or a Bose'-Chaudhuri (BCH) check. If an error is detected, the data word shall be rejected by the receiver and retransmitted by the sender. The receiving station shall positively acknowledge to the transmitter that all messages have been received. The receiving station shall respond with either a busy indication, with valid data, with a read command or by echoing the latest data word of a

write message. The cyclic error detection code used shall be equal to or better than the performance on the CRC-CCITT code.

7. Data communications protocol shall be firmware resident.

E. Data communications software shall be as specified in Section 17120 - Programmable Logic Controllers and Section 17240 - Operator Workstation Software.

F. The Contractor shall supply all hardware, cables, connectors, and software to implement a network as specified herein and shown on drawings.

2.2 ETHERNET NETWORK INTERFACE UNITS

A. Each device connected to the network shall be equipped with its own network interface unit. Bi-directional communications between the LAN and network-connected equipment shall be provided by the network interface units.

B. Network interface units, insofar as possible, shall be common to all equipment.

C. Network interface units shall include all required transceivers, media converters, communications processors, print servers, and memories to provide a transparent interface between the LAN and each individually connected device (operator workstations, peripherals, etc.).

D. Network interface units for PLC equipment shall utilize built-in Ethernet port(s) on the PLC CPU module. Details on PLC equipment shall be as specified in Section 17120 - Programmable Logic Controllers. For the PLCs, Ethernet network interface module shall comply with the following:

1. Built-in Ethernet port on the CPU to minimize backplane delays on data throughput.
2. Minimum 10 Mbps communications - TCP/IP protocol.
3. Support on-line programming over Ethernet with PLC programming software.

E. Network interface units for the operator workstations shall utilize a PCI bus-mounted communication interface card for connection to the LAN. For the OWSs, Ethernet network interface shall meet the following requirements:

1. Speed: 10 and 100 Mbps.
2. Meet IEEE 802.3 10Base-T, IEEE 802.3u 100Base-TX, PCI Bus 2.1/2.2 Standards, and 32-bit interface card.
3. Connectors: (1) RJ-45.

F. Network interface units for PLCs shall be as manufactured by the PLC manufacturers. Network interface units for OWS's shall be as manufactured by 3Com, Intel Pro, LinkSys, or equal.

2.3 ETHERNET NETWORK SWITCH

A. Ethernet network switches shall be provided to create switched Ethernet networks that conform to the IEEE 803.3 and 802.3u standards using copper wires or optical fibers in a bus or ring network topology. Ethernet network switches shall be modular, rack mounted, or standard DIN-rail mounted within the PLC cabinet.

B. Ethernet network switches shall support ring, bus, star, or point-to-point network topologies. On-line signal monitoring shall be provided to detect and locate impending faults. Ethernet network switches shall be replaceable on-line without disrupting the network. The Ethernet network switches shall be integrated into the in-plant Ethernet network to form a redundant ring network with self-healing communication recovery.

C. Ethernet network switches shall meet the following minimum performance requirements:

Functions:	Modular managed switches with store and forward switching mode, 10 Mbps Ethernet or 100 Mbps Fast-Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Each network switch shall manage up to eight (8) ports possible via integrated media modules specified below.
Power Requirements:	Redundant 24 VDC power supply
Operating Temperature:	0° - 60°C
Relative Humidity:	10 - 95%
Network Size:	Up to 50 nodes in ring structure
Port Type & Quantity:	
	Minimum of five (5) 10/100Base - TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment
	Two (2) 100Base-FX, multimode fiber optic cables (62.5/125 µm), ST or SC sockets, 0-5000 meters LAN segment
Link Budget:	8 dB @ 1300 nm; 10 dB @ 850 nm
Wavelength:	850 or 1300 nm

D. Acceptable Ethernet network switches shall be Model RS2-FX/FX (ST) as manufactured by Hirschmann, or equivalent by Phoenix Contact, Modicon, or N-Tron.

2.4 UNSHIELDED TWISTED PAIR CABLE

A. Unshielded twisted pair cable for 10Base-T drops shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek or equal. Connectors shall be modular RJ-45 plug type.

2.5 FIBER OPTIC CABLE

A. Fiber optic cable shall conform to the following specifications:

1. Fiber Type:	Graded Index (GI) Multimode
2. Fiber/Cladding Diameter:	62.5/125 microns
3. No. Fibers:	12, Color-coded
4. Cable Construction:	Loose Tube w/ Ripcords
5. Filling:	Water Swellable Dry Block
6. Armored:	Yes
7. Central Member:	Dielectric (Kevlar)
8. Rating:	Gigabit Ethernet
9. Bandwidth:	200/500 MHz-km at 850/1300 nm
10. Maximum Attenuation:	3.5/1.0 dB/km at 850/1300 nm
11. Application Type:	Direct-burial/Conduit/Aerial
12. Sheath:	UV Resistant
13. Max. Tensile Load:	600 lb (2700 N) installation;
14.	200 lb (890 N) long term
15. Minimum Bend Radius:	7 in (17.4 cm) under maximum tensile load;
	4.6 in (11.6 cm) unloaded (installed)
16. Operating Temperature:	-40 to 70 degrees C

17. Operating Relative Humidity: 0-100%

B. Fiber optic cable shall be ALTOS All Dielectric Loose Tube Optical Cable as manufactured by Corning Cable Systems, the Extended Performance Fiber Optic Cable Series as manufactured by Phoenix Digital, Inc., Belden equivalent, or equal.

C. Upon entering a cabinet, panel or console, loose tube fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. Tight buffered cable shall then be routed to the individual destinations as needed (or loose tube cable for runs to other buildings). Cabinet-mounted patch panels shall be Cabinet-Mounted Interconnect Center (C-MIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., or equal.

D. Where cable is required to be routed to numerous, separate destinations within a building, loose tube cable shall be broken out immediately upon entering the building, terminated in a patch panel, and tight buffered, plenum rated cable shall be routed to the individual destinations. Building patch panels shall be Wall-Mountable Interconnect Center (WIC) or Premises Interconnect Center (PIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., or equal.

E. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

F. Fiber optic cable shall utilize mechanically spliced, field installable, SC, FC, or ST compatible connectors. Connections shall have a typical loss of 0.35 dB or better and shall provide stable optical performance after numerous rematings. Connections shall utilize physical contact terminations utilizing UV or heat cured adhesive. Field terminations shall use a simple procedure requiring minimal training.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Fiber optic cable and appurtenances shall be installed in strict accordance with the manufacturer's requirements.

B. Refer to Section 17000 for further information.

END OF SECTION

SECTION 17190

UNINTERRUPTIBLE POWER SYSTEMS

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SECTION 17190

UNINTERRUPTIBLE POWER SYSTEMS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. One UPS shall be provided for each operator workstation and its peripherals (i.e. printer, network equipment, etc.) provided under this Contract.

C. One UPS shall be provided for each programmable logic controller (PLC) and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC and RTU cabinets shall not be powered by the UPS.

D. UPSs shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:

1. UPSs for operator's consoles shall be mounted within the consoles.
2. UPSs for control panels containing PLCs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.
3. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 17500 and its subordinate Sections.
4. Where the UPS is mounted within the PLC or RTU cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted PLC cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17100 - *Control and Information System Hardware - General.*

C. Section 17120 - *Programmable Logic Controllers.*

1.3 SUBMITTALS

A. The Contractor shall submit UPS sizing calculations for all UPS's furnished under this Contract in accordance with Section 17030 - Control and Information System Submittals.

PART 2 – EQUIPMENT

2.1 UNINTERRUPTIBLE POWER SYSTEMS

A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.

B. UPSs shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the

AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.

C. An automatic bypass switch shall be provided on UPS's of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.

D. A manually operated maintenance bypass switch shall be provided for each UPS installation to allow hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the associated PLC.

E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/RTU.

F. Each UPS shall meet the following requirements:
   1. Input voltage shall be 117 VAC, single phase, 60 Hz.
   2. Voltage regulation shall be +/-5 percent for line and load changes.
   3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.
   4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.
   5. A status monitoring and control panel shall be provided and shall include the following:
      a. Status indicating lights for both normal and abnormal conditions.
      b. Individual alarm contacts that shall close upon loss of the AC line, low battery level or operation of the static transfer switch. Contacts shall be wired to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.
      c. Circuit breaker for the AC input.
   6. Sound absorbing enclosure.
   7. EMI/RF noise filtering.
   8. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.

G. UPS systems shall be Model GXT2 as manufactured by Liebert, equivalent by Powerware, MGE UPS Systems, GE Digital Energy, or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17000, Part 3 of the Specifications.

END OF SECTION

SECTION 17200

CONTROL AND INFORMATION SYSTEM SOFTWARE REQUIREMENTS

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SECTION 17200

CONTROL AND INFORMATION SYSTEM SOFTWARE REQUIREMENTS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all control and information system software with all required programming and software appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17100 - *Digital System Hardware Configuration.*

B. Section 17120 - *Programmable Logic Controllers.*

C. Section 17125 - *Operator Interface Units.*

D. Section 17240 - *Operator Workstation Software.*

1.3 PRODUCT DELIVERY STORAGE AND HANDLING

A. All software manuals and magnetic media shall be protected in accordance with manufacturer requirements so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

PART 2 – PRODUCTS

2.1 SOFTWARE GENERAL REQUIREMENTS

A. Information and control system software shall consist of standard off-the-shelf software configurable by the user to conform to the application. Major software items specified in this Division shall include but not be limited to the following:

1. Programmable logic controller software
2. Operator workstation software (operating system, SCADA, etc.)
3. Database management and report writing software
4. Portable notebook computer software
5. Miscellaneous hardware support software

B. The programmable logic controller software furnished under this Contract shall be as specified under Section 17120 - *Programmable Logic Controllers.*

C. The operator workstation software furnished under this Contract shall be as specified under Section 17240 - Operator Workstation Software.

2.2 OVERALL SYSTEM CONFIGURATION

A. The operator workstation SCADA servers shall be redundant devices with automatic backup capability. If the primary (master) server fails, the backup server shall automatically take over all primary server functions without requiring operator action. All client nodes within the system shall automatically reconfigure to send and receive data to/from the new master server. It shall be possible for the operator to manually force the failover routine and exchange the primary/backup servers at any time. It shall be possible to prioritize the client nodes to allow the most critical clients to connect to the master in the event that the capacity of a single master would be exceeded by a large number of clients.

B. The database management software and its associated report writing software specified herein shall reside on a historical workstation separate from the primary and backup SCADA servers. All system historical data management and reporting software shall be performed on the historical server to relieve the SCADA servers of the historical workload. System data shall be automatically transmitted to the historical server at regular intervals to maintain the database.

C. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. The operator workstation software shall not be used for this purpose.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Software design, implementation and checkout shall satisfy the requirements specified in the various Sections of Division 17.

END OF SECTION

SECTION 17240

OPERATOR WORKSTATION SOFTWARE

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SECTION 17240

OPERATOR WORKSTATION SOFTWARE

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all operator workstation software with all required configuration, programming and software appurtenances as herein specified and as shown on the Drawings.

PART 2 – PRODUCTS

2.1 GENERAL

A. All major and minor updates to the operator workstation software shall be provided to the Owner for no additional cost during the warranty period. Software updates shall be fully installed and made operational.

B. The system shall be upgradable to newer versions using an automatic mechanism provided by the supplier without the need to rebuild or reconfigure databases, displays, drives or related program modules.

C. A mechanism for on-line maintenance and automatic backup, retrieval and purging of files shall also be provided.

D. Hardware-based key locks provided for software shall be interchangeable between workstations. All workstations shall be provided with SCADA client node software keys as shown on the control system block diagram. Work stations shall be identical in function.

2.2 OPERATING SYSTEM SOFTWARE

A. The operating system software shall be the latest version of Microsoft Windows 7 Professional and shall be completely compatible with all specified hardware and software.

2.3 NETWORK COMMUNICATIONS SOFTWARE

A. The network communications software shall be the latest version of Microsoft Windows and shall be completely compatible with all specified hardware and software. Network communications protocol shall be Ethernet and TCP/IP.

2.4 MISCELLANEOUS APPLICATION SOFTWARE

A. Provide the following software for each workstation:
   1. Microsoft Office Professional.
   2. PC Anywhere configured to communicate over the Internet.
   3. SyncBackPro configured to automatically synchronize the hard drives between the two work stations.

2.5 SCADA SOFTWARE

A. The SCADA software shall be the latest version of Wonderware InTouch. The SCADA software package shall be completely compatible with all specified hardware and software. A minimum of one full function SCADA development package shall be provided with the system. All client nodes shall provide full access to control system functions and features, as allowed by individual password security.

PART 3 – EXECUTION

3.1 DATA MANAGEMENT

A. The workstations shall scan the PLC's on demand and as necessary to retrieve and send analog, discrete and virtual input information for displays, control and related operator workstation functions. The current database shall be resident in the distributed network devices as appropriate.

B. Elapsed running time values shall be maintained in the database for all process drives. This data shall be expressed in hours and tenths of hours and shall be updated every sixty seconds using the last scanned value for each associated discrete input. Accumulated runtime data shall be periodically updated (once per hour) in disk memory. The exact time and date of initiation shall be maintained for each runtime accumulation. The operator may, at any time, from any operator workstation, access historical or current accumulated runtime values and either display or print reports containing accumulated runtime for certain specified equipment (i.e., sorted by accumulated hours, equipment ID, etc. within a user specified range) or all equipment. The operator shall be able to selectively reset any or all runtime accumulations to zero (or other legal values). The specified spreadsheet and database software shall be furnished with all required macros/applications to perform the reporting functions.

C. For reporting purposes, the database shall perform averaging and integration on a point basis over the following time periods:
   1. Five second - derived from readings accumulated at scan rates, stored for 3 days.
   2. Five minutes - derived from above 5-second valves, stored for 3 days.
   3. Hourly - derived from above five-minute values, stored for 1 year.
   4. Daily - derived from above one-hour values, stored for 1 year.
   5. Monthly - derived from above shift values, stored for 1 year.
   6. Annually - derived from above monthly values, stored for 1 year.

3.2 GRAPHIC DISPLAY ORGANIZATION - GENERAL

A. The display system described in the following paragraphs only defines those types of displays commonly used during normal operations and overall display organization. Displays shall be based upon information contained on the process flow diagrams, mechanical sheets, electrical drawings, other related drawings, and written narrative descriptions contained in the Specifications. The Contractor shall provide sufficient displays to satisfy all specified plant instrumentation and control system requirements

B. The description of the workstation operation in the remainder of this Section is based on the use of a mouse with screen icons. Should an alternate device be provided, operation shall be functionally equivalent to the procedures outlined below.

C. The following requirements for operator workstation operation are intended to represent a functional specification. Alternative, but equivalent, graphic display formats, organization, and functionality may be submitted for approval by the Owner and Engineer. However, any such substitutions shall conform to all functional requirements specified herein.

D. Each display format may consist of more than one page. If so, the display shall contain the message MORE (or other suitable descriptive text) as an icon on the bottom line and the next page shall be obtained by a strike on the "page forward" (PF) or the MORE icon. Backpaging shall be accomplished by a strike in the "page back" (PB) icon.

E. The Page Forward (FRWD) and Page Back (BACK) icons shall permit the user to page forward and backpage on a multipage listing. If a listing is larger than the capacity of a single CRT page, a MORE icon shall appear on the display. MORE means that there is more data for this display which can be accessed a page at a time with the MORE or FRWD icon. The BACK icon shall be used to reverse the forward display sequence, a page at a time. FRWD or BACK icons shall not be used on a single page display.

F. For map based and/or site plan displays, system pan/zoom features as well as system vertical horizontal and vertical scroll bars may be used for this purpose.

G. Vector targets shall be employed to move vertically and laterally between related displays or, alternatively, the vertical and horizontal window can be used, where appropriate.

H. The formats for all schematic diagrams (e.g., unit process, process partition and control strategy diagrams) shall be based on the site plan, mechanical, and electrical power distribution drawings and shall be submitted to the Engineer and Owner for review. Process displays shall generally be site plan oriented, unless otherwise approved by the Owner. Chemical systems may be shown in a flow schematic format.

I. The operator screens shall be made of any number of the following components, as appropriate:

1. Static and dynamic alphanumeric information.
2. Static and dynamic graphic objects.
3. Dynamic bar graph displays.
4. Dynamic analog trending displays.
5. Password protected operator actions.
6. Screen navigation commands.

J. Dynamic analog information shall be capable of at least eight value related color changes with or without flashing in response to a change in value, state, or alarm condition for linked tags. Dynamic displays linked to digital tags shall be capable of displaying at least three states with corresponding color/flash indications.

K. All data displayed in operator screens on each workstation shall be valid and current. Current values displayed in operator screens shall be instantly replaced with an error indication for "bad" data, loss of data or loss of communications for each individual tag. These conditions shall be treated as alarms, with specified reporting and routing.

L. When communications are restored and/or errors are cleared, data displays shall automatically display actual values, and "change in status" messages shall be routed to all alarm reports and files.

M. While viewing screens, and through password access, operator interaction with individual, modifiable data points shall include: value changes; placing points on/off scan; manual/automatic mode changes; alarm acknowledge; alarm enable/disable; etc.

N. A "pick" point in an operator screen indicates possible operator interaction for data entry, screen navigation or task switching. When the mouse pointer is "dragged" across operator "pick" points, a highlight box shall appear around each. In addition to pointing and clicking, the operator may press the "down" arrow key, to select a "pick" point and then press enter.

O. Point-click procedures shall be available for all operator/screen interface for navigation, data entry, etc. Operator data entry procedures shall be configured as keyboard entry; point-click calculator; multiple choice point-click, up/down ramping or data value slide.

P. Provide user changeable lower, upper and rate-of-change limits on all screen setpoint entry points. Initial limits shall be set at: lower = 10%, upper = 85% and rate-of-change = 10% of value. The user shall not be able to enter setpoint changes beyond these valid limits.

Q. Configure the software at each workstation to check, verify and require appropriate password login prior to each start/stop action, setpoint change, tuning parameter change or any other equipment control or functional change.

R. The system shall respond to each operator request to perform any of these actions in the following manner:

1. Present a "pop up" start/stop faceplate screen with start and stop push buttons for each individually or grouped equipment start/stop system requirement.

2. Present a "pop up" setpoint entry faceplate screen for each system setpoint change requirement.
3. Present a "pop up" control parameter tuning faceplate screen for each system control parameter tuning requirement.
4. English language operator prompting prior to any system response to operator request. Prompting shall inform the operator of the action about to be taken and provide a confirming "proceed" or "quit" choice.
5. Each action and system response shall be clearly displayed in the appropriate "pop up" screen.
6. System response indication shall be the most positive feedback required by this specification. At a minimum, the actual PLC register containing the data to be verified shall be displayed and shall be used for any sequential, interlocked or other related control scheme.
7. At a minimum, each "pop up" screen shall provide for operator input/action and positive feedback indication. Each digital and feedback control display shall provide an English word rather than a digital number indicating conditions. These shall be: start, stop, enable, disable, etc.
8. Each variable input shall allow operator keyboard or vertical slide bar data entry. Each variable, input, and feedback shall be displayed in number and bar graph formats, both individually and in color-coded multiple bar chart for system evaluation.

S. Objects in screens shall indicate field status, such as "stopped" or "running" by appropriate animation, positioning and color coding.

T. The software at all workstations shall be configured to allow password protected user screen configuration without the use of dedicated programmers, the need to change or reconfigure hardware or cabling, or the need to reboot.

3.3 GRAPHIC SCREEN NAVIGATION

A. Each operator screen display shall be configured with a multiple choice Menubar at the top of the screen. Each selection button shall display a related pull down menu of additional selections, screen navigation, system administration, diagnostics and task switching with appropriate password protection.

B. Each selection shall be made by a single point-click or by pressing the "down" arrow to the appropriate selection and then pressing [ENTER]. None of these selections shall cause screen updating, database updating, data collection, alarm monitoring or any other system function to pause or stop.

C. When a Menubar selection is made, the Menubar button and text for that selection shall protrude and become bold to positively indicate user's selection, and the pull-down menu shall be displayed. When pull-down menus are closed or when a new operator screen is displayed, Menubar selections return to previous, normal states.

D. Menubar selections and related pushbutton menu selections and functions shall include:
1. SYSTEM Menubar selection: shall display a pull down menu with the following selections:
   a. SECURITY LOGIN selection: shall display a password login dialogue box, enabling the system user to login by entering an assigned login name and password.
   b. SYSTEM ADMINISTRATION selection: shall provide a pull down menu with the following selections:
      1) SECURITY CONFIGURATION selection: shall display workstation security configuration dialogue boxes enabling the user, through password protection, to modify or disable/enable workstation security functions.
      2) FILE MANAGEMENT selection: shall provide the user with password protected access to Windows file manager.
      3) TASK MANAGER selection: shall provide the user with password protected access to the Windows Task Manager through which any Windows program can be run.

4) HISTORICAL CHART CONFIGURATION selection: shall provide password protected access to workstation historical chart, pen and time group configuration through which the user shall be able to view, add and modify historical data charts.
5) SYSTEM BACKUP selection: shall provide password protected access to the workstation on-board CD-ROM or tape drive backup function, through which the user shall be able to partially or totally backup workstation software files.

c. MESSAGE CENTER selection: shall provide access to a personal message center, through which users shall be able to provide brief messages to other users at any workstation on the network.

d. DIAGNOSTICS selection: shall display a pull down menu providing the following selections:
1) NETWORK STATUS selection: shall provide workstation network diagnostics indicating status of all network sessions, activity and trouble.
2) I/O COMMUNICATION STATUS selection (available on the field I/O server workstations): shall provide password protected interactive display indicating data request/transmit communications status and error conditions between the field I/O server workstation and the PLC data highway.
3) COMPUTER DIAGNOSTICS selection: shall provide password protected total workstation review and diagnoses of computer hardware, memory, drives, ports, etc. This function shall also provide hard copy reporting of the entire diagnostics review or any portion thereof.

e. FIELD I/O AND PLC CONFIGURATION selection: shall provide a set of screens for each PLC including:
1) Manufacturer
2) Model Number
3) Rack I.D.
4) Model number, type and location for each rack module.
5) I/O device, associated database tag, and module position for all field I/O points.

f. SYSTEM ACTIVITY selection: shall provide a password protected pop-up display of live system activity including alarms, alarm resets, operator entries, communication errors, system messages and database configuration activity. This display shall be used to provide real time feedback for operator requests, troubleshooting, alarm management assistance, etc. This pop-up display shall be sized, moved, closed and set to be always "on-top" during screen navigation by user request and at any time without pausing or stopping data updates, data collection or alarm monitoring.

2. ALARM Menubar selection; shall provide user interactive alarm summary screen as specified in the alarms section of this specification.

3. HELP Menubar selection: shall provide project-specific full-function Microsoft Windows help including: "contents", "search", "back", etc.

4. TREND Menubar selection: shall provide a pull down menu selection listing for:
a. LIVE TREND choice: shall provide a multiple trend menu of predefined live trends.
b. HISTORICAL TREND selection: shall provide a menu selection listing of predefined historical trends.

5. REPORTS Menubar selection: shall provide access to a menu listing for all configured reports with features as described herein.

6. DISPLAY MENU Menubar selection: shall display a menu of all plant area displays for screen navigation.

7. OVERVIEW Menubar selection: shall display the plant overview screen.

8. PRINT Menubar selection: shall print the current display.

9. CONTROL PANEL Menubar selection: shall provide date and time display and access to Microsoft Windows Control Panel. A single point-click action from a supervisor's security level or above shall display the Control Panel icon group through which modification can be made for:
a. System Date and Time
b. System Fonts
c. Printers Setup
d. Other Standard Windows Control Panel Functions

3.4 PROCESS OVERVIEW DISPLAY(S)

A. The process overview graphic display shall be obtained by selecting the OVERVIEW icon. One or more targets or icons shall be provided for each unit process and shall permit the operator to directly access an associated unit process display. The plant site plan layout shall be used as the basis for the process overview display, which shall provide display vectoring functions to subordinate unit process displays. A separate display containing a text-based listing of all system graphic displays shall also be provided, accessible from the Overview Display or a separate Menubar selection.

B. Intermediate process overviews shall be provided to summarize information from a number of similar or identical unit process equipment items (e.g., filter overview showing all filters, aeration system overview, etc.). These intermediate overview displays shall allow vectoring to/from the plant overview(s) and the individual equipment detail displays, and shall show appropriate summary process data.

C. Windowed Real-Time Trends: Each operator workstation shall have two active monitors. One monitor shall be configured with multiple screens to display eight real-time trends per screen to include trending for all analog values input to the SCADA system. Provide pick points for quick screen switching between trend screens. All eight filter effluent turbidity trends shall appear on one screen.

3.5 UNIT PROCESS DISPLAYS

A. Unit Process Graphic Displays shall be provided to show all plant process areas and equipment in detail. Except where specified otherwise, all operator control actions shall be performed at the Unit Process Display level. Any unit process display shall be selectable from the process overview display or from an adjacent process area or otherwise related process display. A unit process display shall be a schematic representation of a process and use standard symbols to represent process equipment such as pumps, tanks, motors, etc. Process status shall be indicated using both color and alphanumeric annotations. Symbol color coding for all displays shall be based on the following convention:

1. All text shall be shown in white except alarm condition statements that are illuminated in either yellow or magenta.
2. Yellow blinking = device has a noncritical alarm not yet acknowledged.
3. Yellow = device has a noncritical alarm that has been acknowledged.
4. Magenta blinking = device has critical alarm not yet acknowledged.
5. Magenta = device has a critical alarm that has been acknowledged.
6. Cyan = device off or not available. This may represent future equipment or equipment that has been taken off line for maintenance purposes.
7. Red = device is on, running, energized, open.
8. Green = device is available, ready to run, de-energized, closed.
9. White with a black target background = device is in automatic (or semi-automatic) control mode.
10. White with a blue target background = device is in manual mode.

B. The displays shall show all ID number, current status values and setpoints associated with a given process display and shall be updated with current values every five seconds or less.

C. The control status of each controllable device shall be modifiable and shall be displayed in text adjacent to that device. Control status shall be AUTO, MANUAL, AVAILABLE, etc., and shall be updated continuously. When the operator wishes to take control of the device or modify setpoints, the procedure shall be as follows:

1. The operator shall click on the device symbol with the mouse.
2. A dialog box shall appear which provides the current state or setpoint and enables the operator to make the appropriate change.
3. For two-state devices, the dialog box shall allow the operator to start or stop, open or close, or otherwise change the state of the device.

4. For setpoints and modulating final control devices (analog outputs), the dialog box shall display the old value, and shall allow the operator to enter a new value using standard Windows editing techniques. It shall also be possible for the operator to ramp the current value up and down by clicking on ramp targets.
5. Prior to the execution of the operator-commanded action, a confirmation message and target shall be displayed stating the old and new values and asking the operator to confirm the modification.
6. Control strategies shall be changed from AUTO to MAN or OFF (or vice versa) in the same manner as two-state devices.

3.6 ALARM AND EVENT CONFIGURATION

A. The operator workstation software shall be configured to provide alarm handling, reporting and archiving. Alarm grouping, printing and display shall be coordinated with Owner personnel prior to configuration.

B. Alarm management shall be provided for each database field input and shall include:
1. Alarm reporting enable or disable.
2. Alarm suppression to avoid nuisance alarms such as start up spiking.
3. Re-alarming.
4. Alarm routing to specific workstations and printers as appropriate.
5. Alarm grouping for specific visual and audible group notification.
6. Analog alarm types to include at least: low low; low; high; high high; rate of change; deviation; deadband; bad input; and off scan.
7. Discrete alarm types to include at least: change from normal; return to normal; change of state; bad input; and off scan.
8. Alarm acknowledgement and condition clear format.

C. The operator workstation software shall provide date and time stamped alarm reporting to at least five destinations. These destinations shall be:
1. Operator screen alarm summaries.
2. Alarm printers.
3. System alarm and history file.
4. System alarm and history display.
5. Workstation network.

D. All points or modules that have the capability of being alarmed for amplitude or rate of change limit violations, and all discrete alarm inputs shall be linked to an associated discrete point for alarm suppression under specified conditions. For example, when there is no flow through a flow meter, the "not running" signal from the associated prime mover shall be used to suppress all alarms associated with the flow signal. Time delays shall be provided as necessary to eliminate transient alarm annunciation under start-up/shutdown conditions.

E. All alarms shall be OLE and Windows Sound System enabled. Sound files shall be individually assigned to each alarm point.

F. The system shall provide an alarm summary display as a pre-defined dynamic link within the graphics package. This alarm summary display shall show a list of the pending alarms in the system. As new alarms are detected, entries shall be made to the display list. As the alarm conditions clear, the entries shall be removed from the list.

G. The alarm summary display shall be user-configurable to the extent that the user can select the placement of tag name, current value, descriptor, time of alarm, and alarm status on the line as well as the color codes to be used to indicate the various alarm conditions.

H. Only alarms, including the loss of network, data highway and individual field I/O point communications, shall be reported to operator screen alarm summaries, which shall allow the operator to sort alarms in descending or ascending time order. The operator shall also be allowed to apply various priority level filters and to reconfigure alarm summary columns for detailed analyses, while viewing.

I. Alarms shall be acknowledged from the alarm summary display either individually (by clicking on an alarm acknowledgement field) or by a full page using a menu pull-down. The system shall support up to twenty (adjustable) alarm messages in the summary display.

J. Each graphic display shall be configured with the indication of the last three alarms at the bottom of the screen.

K. An unacknowledged alarm shall flash in configured foreground/background colors until it is acknowledged. When an alarm is acknowledged, it shall stop flashing but remain displayed until the alarm condition is cleared.

L. When an alarm condition has been both acknowledged and cleared, the alarm statement shall be removed from the alarm summary.

M. Alarm summaries shall use system colors and provide at least the following column information:

1. Date and time
2. Workstation name
3. Tag number
4. Tag description
5. Alarm condition
6. Tag value

N. Configure alarm summaries with a distinctive color format for:

1. Background color
2. High value alarms
3. Low value alarms
4. Rate-of-change alarms
5. Digital status alarms such as change of state, change from normal, etc.
6. Plant area/access alarms

O. The following color codes shall be used in conjunction with alarm displays:

1. Cyan = normal.
2. Yellow, blinking = noncritical, not acknowledged alarm.
3. Yellow = noncritical, acknowledged alarm.
4. Magenta, blinking = critical, not acknowledged alarm.
5. Magenta = critical, acknowledged alarm.

P. The following alarm condition statements shall be provided as a minimum:

1. RTN NRML - Return to Normal
2. HIHI LMT - Second High Limit
3. HI LMT - High Limit
4. LO LMT - Low Limit
5. LOLO LMT - Second Low Limit
6. ROC LMT - Rate of Change Limit
7. STAT CHGE - Status Change
8. OFF SCAN - Off Scan
9. OPEN FAIL - Open Failure
10. CLOSE FAIL - Close Failure
11. START FAIL - Start Failure
12. STOP FAIL - Stop Failure
13. FAULT - Fault
14. HI DEV - High Deviation
15. LO DEV - Low Deviation
16. DISCREP - Discrepancy
17. UNAVAIL - Unavailable

Q. Date and time stamped alarm reporting shall be sent to alarm printers with similar formatting, configuration and routing procedures as specified for alarm summaries.

R. Configure alarm and history files for sequential date and time stamped activity reporting for the entire system, on each workstation. This file shall be a daily text file with a file name indicating the date that the file was created, and shall include all system wide activity including:
   1. Alarms.
   2. Alarm acknowledgement.
   3. Loss and recovery of network, data highway and individual field I/O point communications.
   4. Status changes.
   5. Alarm clear and return to normal messages.
   6. Operator keyboard entries.
   7. Other system related activity (system startup, save/reload database, etc.).

S. Information format shall include:
   1. Date and time.
   2. Description.
   3. Condition.
   4. Current value.

T. Alarm and history files shall be saved to computer backup media including CD's or tapes if selected by the operator.

U. The alarm and history display shall provide live viewing of alarm and history file entries, giving the operator instantaneous activity review and operator action verification.

V. The system alarm and history display, with on-line height and width adjustment capabilities, shall be displayed as part of operator screens, upon demand. The operator shall be able to size and move the display, as desired. Further, the operator shall be able to close this display, upon demand, or cause it to be continually displayed as the operator navigates through operator screens.

W. The opening, closing, moving or resizing of this display shall not cause screen updating, database updating, historical data collection, alarm monitoring or any other system function to pause or stop.

X. Workstations shall be configured to report all alarm conditions, operator activity, etc. to all other workstations.

Y. The system shall be configured to provide a periodic date stamp on the alarm printout at the alarm printer to provide clear date/time evaluation of printed alarms.

Z. Each workstation shall be configured for alarm and history activity file backup and archiving to the on-board tape or CD drive. The instrumentation subcontractor shall provide alarm and history file backup, and disk space management procedures.

3.7 SYSTEM SECURITY

A. Security privileges shall be configured for all individual and group users, with security privilege checking at the individual workstation as well as across the local area network.

B. Through appropriate password clearance, individual workstation security enable/disable, configuration or modification shall be done on-line and at any time, without rebooting the workstation software system, software platform or the computer.

C. The security system shall be configured to provide the following:
   1. Observer:
      a. Graphic display viewing and navigation.
      b. Historical data display.
      c. Password login and logout.
      d. Observer shall be the system default security mode.

2. Operator:
    a. Observer privileges.
    b. Password protected start/stop, setpoint entries, system activity display, etc.
3. Lead Operator/Supervisor:
    a. Operator privileges.
    b. Historical data chart configuration.
    c. Report viewing, modification and exporting/printing.
    d. Task switching to the Windows operating system.
    e. Software system shut down.
    f. Windows XP Task Manager access.
4. System Administrator/Engineer:
    a. All privileges.

D. The software at each workstation shall be configured to automatically log in the observer group upon system startup.

E. The security system at each workstation shall be configured to not allow SCADA software shut down or Windows security access unless requested through Supervisors' or System Administrator security privileges.

F. The security configuration shall be exportable to a text file, which shall not include passwords. This text file shall have a user defined acronymic, mnemonic file name and shall be capable of being imported into the system to modify or create workstation security configuration.

G. All workstation security activity, including violations, shall be reported in a date and time stamped format to a daily text file for review and evaluation at any time. This security text file shall have a file name indicating the date that the security file was created. It shall be possible for any text editor to edit these files.

H. Each workstation shall be configured for security activity file backup and archiving to the on-board tape drive.

I. Process data security: Both work stations shall continuously log all process data to the station hard drive. These drives shall be synchronized automatically and each shall contain all the logged process data.

J. Firewalls: The workstations shall have internet access and shall be protected against hacking and other unauthorized intrusions by hardware or software firewalls. Provide encryption for data protection when transmitting over the internet.

3.8 TRENDS CONFIGURATION

A. The system shall provide multiple sets of live trends in operator screens. Each set of live trends shall be capable of the following:
    1. Displaying up to eight pens.
    2. Being temporarily modified, while viewing.
    3. Displaying straight line or varying data value "target" curves.
    4. Full screen trend curve displays when trend screen is opened.

B. Each live trend chart shall allow temporary, on-line pen, range and chart X-Y parameter changes by the user. Each trend display shall allow on-line user modifiable straight-line "target" curve for each trended data point and, as specified, a user selected varying data value "target" curve based on pre-defined modeling for trended data points.

C. Trends shall automatically shut down and release system resources when closed.

D. The instrumentation subcontractor shall provide preconfigured real-time and historical trends for all analog inputs to the SCADA system.

3.9 HISTORICAL DATA MANAGEMENT CONFIGURATION

A. The operator workstation SCADA, database, spreadsheet and reporting software shall be configured to provide historical data gathering for system and operations validating, testing, maintenance and regulatory reporting.

B. The system shall provide multiple choice options for historical data file size and shall automatically assign file names indicating the date and duration for data contained in each file. The installed system shall be configured for sequential data files beginning at midnight.

C. For data and system resource management the system shall allow the assignment of any number and type of database tags and tag groups for historical data collection with the following attributes:
   1. Collection rate and phasing.
   2. Data collection start/stop condition.
   3. Data collection deadband.

D. For additional resource management, the operator workstation software shall be configured to automatically delete historical data files when they reach a certain age, which is user selectable from a multiple choice options list. Set initial automatic file deletion at 20 days with backup and archiving procedures occurring prior to deletion.

E. Configure each workstation for automatic historical data files backup and archiving to the CD drive. The operator shall be notified if the automatic archival function does not occur as scheduled.

F. Provide historical data files backup, and disk space management procedures.

G. All attributes of each historical display chart shall be able to be configured or modified at any time.

H. In addition, the user shall be able to make temporary, view only modifications, while viewing historical trend charts.

I. The system shall be configured for the following on-line historical data user functionality, without pausing or stopping any system function:
   1. Zoom to any specific area of a chart.
   2. Automatic real time update of historical data, upon demand.
   3. Reset to original trend chart parameters, upon demand.
   4. Request completely different start/stop time and duration parameters, upon demand.
   5. Chart data display update forward or backward in time, by a single point-click for two sets of modifiable time increments in each direction.
   6. Export displayed trend chart data into a text file with a user defined acronymic, mnemonic file name.
   7. Print any displayed historical trend chart, upon demand.
   8. Display multiple historical trend charts at the same time with time synchronizing for detailed analyses.
   9. Data trend charts configured by combining any pen and time groups.
   10. Trend chart display format changes including colors, titles, legends, etc.

J. When configuring tag pen groups, the system shall provide for user configuration of at least:
   1. Individual tag and related attributes.
   2. Default or specific data value range.
   3. Individual color for each tag pen.
   4. A specific letter to further document each pen related curve.
   5. Trend chart display format.

K. Time group configuration shall include at least the following:
   1. Start/stop dates and times.

2. Duration.
3. Sample, average value, high value and low value displays individually or together.
4. Trend chart display format.

L. Historical data files shall be saved to computer backup media (optical disk or removable USB flash drive). The system shall allow these files to be restored to the appropriate system file path and reviewed with all system functions at any time, as if they had continued to be hard disk resident.

M. The collection of historical data shall begin automatically upon software system start-up.

N. All analog and digital field inputs shall be historically collected. Provide collected data in the "sample" mode with collection rate, phasing, etc. attributes assigned to maximize data collection and system resources.

O. Provide the following time groups:
1. The previous hour.
2. The previous twenty-four (24) hours.
3. The previous thirty (30) days.

P. Operator access for viewing or printing any individual project specific, pre-defined historical trend chart shall be through a single point-click action while viewing operator screens via the TREND Menubar selection.

3.10 SYSTEM CONFIGURATION AND EXPANSION

A. The system shall provide an on-line installation and configuration program for configuring the various computers on the network. This configuration software shall allow assigning unique node names to each computer as well as selecting the functions that the machine will perform.

B. The system shall allow additional computers to be added to the network while on-line, without disrupting the operations of the other machines.

3.11 DIAGNOSTICS

A. The system shall provide on-line diagnostics that display the current status and operation of the local area network and its nodes. The diagnostic display shall include the LAN adapter status for the machine showing the display, as well as the current number of messages, errors and retries.

B. An additional display shall show the current session status (established, pending, offline) of all stations on the network. A session monitor program that automatically monitors and recovers communications shall be supplied with the system.

END OF SECTION

SECTION 17500

ENCLOSURES - GENERAL

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SECTION 17500

ENCLOSURES - GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17100 - *Control and Information System Hardware - General.*

C. Section 17510 - *Cabinets and Panels.*

D. Section 17520 - *Field Panels.*

E. Section 17540 - *Control System Furniture.*

F. Section 17550 - *Panel Instruments and Accessories.*

G. Section 17560 - *Transient Voltage Surge Suppression Devices.*

H. Section 17600 - *Unpowered Instruments - General.*

I. Section 17700 - *Powered Instruments - General.*

J. Section 17800 - *Analytical Instruments - General.*

K. Section 17900 - *Schedules and Control Descriptions - General.*

L. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.3 GENERAL INFORMATION AND DESCRIPTION

A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.

B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.

C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The

Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

1.4 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the spare parts items shall be provided as specified in the individual cabinet and panel specification sections (175XX).

PART 2 – PRODUCTS

2.1 TERMINAL BLOCKS

A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Wieland, Square D, or equal.

B. Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30 amps.

C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

PART 3 – EXECUTION

3.1 FABRICATION

A. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.

B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:

1. Louvered openings near the bottom and top (NEMA 12 cabinets only).
2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75°F) to circulate air within the enclosure, maintaining a uniform internal temperature.
3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.
4. All openings in cabinets and panels shall be fitted with dust filters.

C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.

D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.

E. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.

F. Wiring shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 16 of the specifications. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.

G. Separate terminal strips shall be provided for each type of power and signal used within each cabinet.

H. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring.

I. A copper 120 VAC ground bus shall be installed in each cabinet, and shall be connected to the building power ground. A separate, isolated copper ground bus shall be installed in each cabinet for the logic (24 VDC) ground. Both ground buses shall be clearly labeled as to voltage and function.

J. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire numbering system and identification tags shall be as specified under Division 16. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

K. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK
120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED
120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED
DC Power (-) - BLACK
DC Control - BLUE

Analog Signal - BLACK/WHITE or BLACK/RED

L. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.

M. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and fluorescent service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.

N. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power". Letters in the word "WARNING" shall be 0.75 inch high, white.

O. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.2 PAINTING

A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 9 for additional requirements.

B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.

C. Panels fabricated from stainless steel shall not be painted.

3.3 INSTALLATION

A. Refer to Section 17000 for additional requirements.

END OF SECTION

SECTION 17510

CABINETS AND PANELS

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SECTION 17510

CABINETS AND PANELS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the cabinets and panels, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - Control and Information System Scope and General Requirements.

B. Section 17100 - Control and Information System Hardware - General.

C. Section 17500 - Enclosures - General.

D. Section 17900 - Schedules and Control Descriptions - General.

PART 2 – PRODUCTS

2.1 CABINETS AND PANELS

A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.

B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.

C. Cabinets and panels located inside buildings, but located in areas other than climate controlled (heated and air conditioned) electrical or control rooms, shall be as a minimum 316 stainless steel NEMA 4X construction, or as specified or shown on the Drawings for hazardous area classification (Class, Division, Group), or submersible (NEMA 6) applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications. Cabinets located in chlorine storage/feed areas shall be of non-metallic, FRP construction, rated NEMA 4X.

D. Cabinets and panels within climate controlled (heated and air-conditioned) electrical or control rooms shall be all steel fully enclosed NEMA 12 units with gasketed doors.

E. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Door latches for NEMA 4X cabinets shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure. Door hardware on NEMA 4X cabinets located in chlorine storage/feed areas shall be non-corrosive in that environment.

F. Panels and cabinets located outside fence-secured areas shall be fitted with padlockable latch kits.

G. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.

H. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC) shall be provided with a folding laptop programmer shelf on the inside of the door.

I. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Rittal. The Contractor may optionally provide cabinets that are custom-fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

END OF SECTION

SECTION 17530

OPERATOR WORKSTATIONS

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SECTION 17530

OPERATOR WORKSTATIONS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation two operator workstations, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 TOOLS, SUPPLIES AND SPARE PARTS

A. Contractor shall provide one of each type of printed circuit board (except motherboard) and power supply used in operator workstations furnished under this Contract.

PART 2 – PRODUCT

2.1 OPERATOR WORKSTATIONS

A. The equipment shall be designed to operate in an indoor environment. The equipment shall be capable of operation in an ambient temperature range of 0° to 40°C and a relative humidity of 0-90%, non-condensing. The equipment shall be capable of operation on supply voltages of 102-132 VAC at 47-63 Hz. Each operator workstation shall, as a minimum, include one or more microcomputers (personal computers) and appurtenances as specified below.

B. All operator workstation hardware and associated peripherals shall be approved for use with the operator workstation SCADA software specified in Section 13600.

C. Uninterruptible Power Systems:

1. Uninterruptible power systems shall be furnished for each operator workstation and appurtenances.

D. Provide two Dell Precision T3500, or equal, computer systems each with features listed below:

1. Operating System: Windows 7 Professional
2. Processor: Six Core Intel Xeon W3680 3.33GHz
3. Memory: 4GB, 1333MHz, DDR3 SDRAM
4. Graphics: 2.0GB Triple Monitor
5. Hard Drive Configuration: All SATA or SSD drives, for 2 Hard Drives
6. Hard Drive Controller: Integrated Intel chipset SATA 3.0Gb/s controller
7. Boot Hard Drive: 300GB SATA, 10K RPM Hard Drive with 16MB Cache
8. 2nd Hard Drive: 300GB SATA, 10K RPM Hard Drive with 16MB Cache
9. CD-ROM, DVD and Read-Write Devices: 16XDVD AND 16XDVD+/-RW
10. Monitors: Two G2210 22in Wide Monitors, VGA/ DVI
11. Keyboard and Mouse: Wireless
12. Printer: Multifunction Color Laser Printer

E. Network Interfaces:

1. Network interfaces shall be furnished in accordance with Section 13610 of the Specifications.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 13600 the Specifications.

1 END OF SECTION

SECTION 17540

CONTROL SYSTEM FURNITURE

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SECTION 17540

CONTROL SYSTEM FURNITURE

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish and install the control system furniture and accessories, as specified herein and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - Control and Information System Scope and General Requirements.

B. Section 17100 - Control and Information System Hardware - General.

C. Section 17500 - Enclosures - General.

D. Section 17900 - Schedules and Control Descriptions - General.

1.3 GENERAL INFORMATION AND DESCRIPTION

A. The location of furniture shown on the Contract Drawings shall be used as a guide only, and may not include all the required accessories or hardware that may be required for a complete installation.

PART 2 — PRODUCTS

2.1 COMPUTER DESKS

A. The Contractor shall provide computer desks for the operator workstations as specified herein and as shown on the Contract Drawings. Arrangement of furniture shall be as shown on the Contract Drawings.

B. Computer desks shall have modular components which combine to form a desk-based system as specified herein. Components shall be fabricated from steel with a scratch resistant coating. Computer desks shall have the following components and features:

1. Articulated keyboard arm that provides up, down, in, out, and tilt adjustments.
2. Tilt/swivel CRT stand that provides CRT positioning versatility for more comfortable viewing.
3. Wire management and grommet packages for routing of the cables.
4. Slide out trays to hold electronic components.
5. Pencil drawer, and slide-out under counter storage drawers
6. Side-opening louvered panels, steel hinged door with lock, and levelers.
7. Separate vertical rack cabinets shall be provided under desk sections where required for mounting of additional digital hardware. The rack cabinet shall be designed for industry standard 19" rack mounted devices.

C. Work surface shall be constructed of high pressure, scratch resistant laminate. Work surface patterns and colors shall be selected by the Owner.

D. Computer desks shall be by Allsteel Inc. 8900 Series, or equal.

2.2 COMPUTER CHAIRS

A. The Contractor shall provide computer chairs as specified herein and as shown on the Contract Drawings.

B. Chairs shall have swiveling seat, adjustable height back, pneumatic/hydraulic height adjustment, lumbar back support, and rolling casters. Finish color option shall either be black, gray or burgundy as selected by the Owner.

C. Computer chairs shall be as manufactured by Kimball, United Chair, or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

END OF SECTION

SECTION 17550

PANEL INSTRUMENTS AND ACCESSORIES

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SECTION 17550

PANEL INSTRUMENTS AND ACCESSORIES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the panel instruments and accessories, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17100 - *Control and Information System Hardware - General.*

C. Section 17500 - *Enclosures - General.*

D. Section 17900 - *Schedules and Control Descriptions.*

1.3 GENERAL INFORMATION AND DESCRIPTION

A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

1.4 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One of each type of panel mounted equipment (i.e., indicators, signal converters, etc.) provided under this Contract.
2. Five of each type of interposing relay provided under this Contract.

PART 2 – PRODUCTS

2.1 ELECTRONIC INDICATORS

A. Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be Red Lion Model IMP or APLCL, or equal.

2.2 SIGNAL CONVERTERS

A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.

B. General Requirements - Converters shall be of the miniature type, utilizing all solid state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided. Power supply shall be 120V, 60 hertz where required by the converter. Repeatability shall be 0.1%

of span, deadband shall be 0.1% span, maximum. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.

C. Current to Current Isolators - Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

D. Voltage to Current Transducers - Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4-20 milliamp DC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

E. Frequency to Current Transducers - Frequency to current transducers shall convert pulse-rate and pulse-duration signals to 4-20 mA, 24 VDC analog signals. Converters shall include field-adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Timeverter as manufactured by AGM, Moore Industries equivalent, Rochester Instrument Systems (RIS) equivalent, or equal.

F. Current to Frequency Transducers - Current to frequency transducers shall convert 4-20 mA, 24 VDC analog signals to pulse-rate and pulse-duration signals. Converters shall include field-adjustable output frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Quantimer as manufactured by AGM, Moore Industries equivalent, Rochester Instrument Systems (RIS) equivalent, or equal.

G. Integrators - Integrators shall be provided as interchangeable plug-in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be $\pm$ 0.1% of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid-state output. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), or equal.

H. Electronic Switches (Alarm Relays) - Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4-20 mADC, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2 percent of span. The set point stability shall be $\pm$0.1% per degree F. The repeatability shall be $\pm$0.1% of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

I. RTD to Current Signal Converters - RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4-20 mADC output signal. Each converter shall operate from a 120 VAC power source. Accuracy shall be 0.10 percent of span or better. Calibrated span of each converter shall be as indicated on the instrument list. The Contractor shall coordinate calibration of the signal converters with existing RTD elements. The signal converters shall be furnished in the manufacturer's standard enclosure for installation in an existing indoor electrical cabinet. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

J. Interposing Relays - Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be miniature type, DPDT, minimum 10 amp, 120 VAC contact

rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall be Type KU as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.

K. Timing Relays - Timing Relays (TR) shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, Cutler-Hammer/Westinghouse Electric Corporation equivalent, Allen-Bradley equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.

L. Intrinsically Safe Relays and Barriers - Intrinsically safe relays and barriers shall be provided where required to interface with equipment such as float level switches that are located in NFPA-classified hazardous areas. Intrinsically safe relays and barriers shall be FM approved and shall be manufactured by Pepperl and Fuchs, Crouse Hinds, Square D, or equal.

2.3 TOTALIZERS

A. Totalizing counters shall be provided for flush panel, spring-clip mounting. Face dimensions of the totalizing counters shall be no larger than 1-1/8-inches high by 2-inches wide. Totalizing counters shall contain eight digits. Height of the digits shall not be less than 5/32-inch. Numerals shall be white on a black background. The counter shall be non-resettable and shall be totally compatible for operation on the pulses supplied by the associated instrument or integrator. The totalizing counter shall be capable of a maximum count rate of 25 counts/second.

B. Legend plates shall be provided for each of the totalizing counters with white letters on a black background with legends as specified below.

C. Totalizing counters shall be manufactured by Kessler-Ellis, or equal.

2.4 ACCESSORIES

A. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant.

B. Pushbuttons and selector switches shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release. Pilot lights shall be of the proper control voltage, LED type with light lens colors shall be as specified below.

Color	Function
Red	Running (Open)
Green	Stopped or Off (Closed)
Amber	Fault
White	Other

C. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.

D. Control operators for all equipment shall be as specified herein and of the same type and manufacturer unless otherwise specified or indicated on the Drawings.

E. Alarm horns shall be general-purpose type, flush panel mount, 115 VAC power supply or 24 VDC power supply, suitable for indoor or weatherproof service, as required. Volume shall be adjustable.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

END OF SECTION

SECTION 17560

SURGE PROTECTION DEVICES

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SECTION 17560

SURGE PROTECTION DEVICES

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, install and place in satisfactory operation the surge protection devices (SPDs) as specified herein and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17100 - *Control and Information System Hardware - General.*

C. Section 17500 - *Enclosures - General.*

D. Section 17900 - *Schedules and Control Descriptions - General.*

1.3 GENERAL INFORMATION AND DESCRIPTION

A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

1.4 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. Five of each type of surge protection device provided under this Contract.

PART 2 — PRODUCTS

2.1 ELECTRICAL TRANSIENT PROTECTION, GENERAL

A. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.

B. Manufacturer's Requirements: All surge protection devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, or equal.

C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.

D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.

E. Device Locations: As a minimum, provide surge protection devices at the following locations:

1. At any connections between ac power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.
2. At both ends of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.
3. At both ends of all copper-based communications cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

4. On all external telephone communications lines.

2.2 AC POWER PROTECTION

A. Surge protection device assemblies for connections to AC power supply circuits shall:
   1. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.
   2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.
   3. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events, and shall have status indication lights.
   4. Comply with all requirements of UL 1449, second edition.
   5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.
   6. Have the following characteristics:
      a. Maximum Continuous Operating Voltage: 150VAC
      b. Maximum Operating Current: 20 amps
      c. Ambient Temperature Range: -20 degrees C to +65 degrees C
      d. Response Time: 5 nanoseconds

2.3 ANALOG SIGNAL CIRCUIT PROTECTION

A. Surge protection device assemblies for analog signal circuits shall:
   1. Have four lead devices with a threaded mounting/grounding stud or DIN Rail mounting.
   2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.
   3. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.
   4. Comply with all requirements of UL 497B.
   5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.
   6. Limit line-to-line voltage to 40 volts on 24VDC circuits.
   7. Have the following characteristics:
      a. Maximum Continuous Operating Voltage: 28VDC
      b. Ambient Temperature Range: -20 degrees C to +65 degrees C
      c. Response Time (Line-to-Line): 5 ns

2.4 COMMUNICATION CIRCUIT PROTECTION

A. Surge protection devices for copper-based data communication circuits shall:
   1. Be designed for the specific data communication media and protocol to be protected (i.e., telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF, etc.).
   2. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:
      a. IEC 60-1 / DIN VDE 0432 part 2.
      b. CCITT K17 / DIN VDE 0845 part 2.
      c. IEEE C62.31
   3. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.
   4. Provide automatic recovery.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

END OF SECTION

SECTION 17600

UNPOWERED INSTRUMENTS - GENERAL

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SECTION 17600

UNPOWERED INSTRUMENTS - GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The instrumentation subcontractor shall furnish, install, test and place in operation process instrumentation (flow elements, pressure switches, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process controls as shown on the Drawings and as specified. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at <u>all</u> process taps.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17500 - *Enclosures - General.*

C. Section 17698 - *Instrumentation and Control System Accessories.*

D. Section 17700 – *Powered Instruments - General.*

E. Section 17800 – *Analytical Instruments - General.*

F. Unpowered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.3 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050.

B. In addition to the above requirements, the instrumentation subcontractor shall provide spare parts as specified in individual instrument specification sections.

PART 2 — PRODUCTS

2.1 GENERAL

A. Unless otherwise specified, instruments shall be provided with enclosures to suit specified environmental conditions. Field-mounted devices shall be rugged and mounted on walls or pipe stanchions.

PART 3 — EXECUTION

3.1 INSTALLATION

A. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.

B. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.

C. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.

D. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.

E. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

3.2 ADJUSTMENT AND CLEANING

A. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.

D. Field instrument calibration requirements shall conform to the following:

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument

supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.

2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
5. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

END OF SECTION

SECTION 17610

INSERT VENTURI FLOW TUBES

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SECTION 17610

INSERT VENTURI FLOW TUBES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all insert venturi flow tubes, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17600 - *Unpowered Instruments - General.*

C. Section 17760 - *Pressure Indicating Transmitters.*

1.3 SUBMITTALS

A. The manufacturer shall provide data that substantiates head loss and accuracy for the flow tubes submitted, which shall include the following information:

1. Differential vs. flow curves.
2. Differential vs. flow data in tabular format.
3. Non-recoverable head loss data.
4. A certified dimensional drawing for each flow tube.
5. Specific equations for calculating airflow in scfm or liquid flow in gpm, as appropriate, in the following format:

$$\text{Actual scfm} = \text{constant} \times \frac{(\text{Differential P})^{1/2} \times (\text{Operating Press.})^{1/2}}{(\text{Operating Temp.})^{1/2}} \qquad \text{(Gas)}$$

$$\text{gpm (or mgd)} = \text{constant} \times (\text{Differential P})^{1/2} \qquad \text{(Liquid)}$$

B. Two copies of each of the following curves with plastic see-through type envelopes shall be furnished for each venturi tube by the manufacturer:

1. Certified differential pressure vs. flow at nominal static pressures.
2. For airflow, flow coefficient vs. pressure for above curves for a pressure range of ±3 psig from the nominal static pressures.

PART 2 – PRODUCTS

2.1 INSERT VENTURI FLOW TUBES

A. The Contractor shall furnish the exact internal diameter of process piping to the instrumentation subcontractor for fabricating and calibrating flow tubes. The flow tube shall have pressure and temperature capabilities at least equal to the surrounding air piping. The Contractor shall coordinate end conditions for installation allowing for future removal of the tube by use of expansion fittings and flanges in the pipeline, as shown on the Drawings.

B. Insert flow tubes shall produce a differential pressure proportional to the square of flow. Inlet and outlet cones shall be made of polyester resin reinforced with 30 percent fiberglass by weight or stainless steel. The outlet cone angle shall be 10° or smaller for optimum energy recovery. The venturi meter shall have a cylindrical, precision-machined, 304 stainless steel throat section with a minimum length equal to 0.5 times its diameter. Center flange material shall be epoxy-coated carbon steel, and shall match the pressure classification of the surrounding pipe. Flange gaskets shall be provided for sealing and shall

be consistent with the rest of the gaskets used in the pipeline. Flow tube shall be designed for operation on air lines with temperature ranging from 0°F to 225°F.

C. Pressure taps shall be ½-inch or ¼-inch NPT as recommended by the manufacturer, constructed of 316L stainless steel. If the ¼-inch taps are furnished, appropriate fittings shall be provided to connect to the ½-inch process tubing. The low-pressure sensing tap shall be installed in the cylindrical throat section of the flow tube. The static or high-pressure sensing tap shall be located in the upstream spool piece of the flow tube. Location of the upstream tap shall be directed by the flow tube supplier. Corner-type high-pressure taps shall not be acceptable. Flushing/drain assemblies with stainless steel ball valves for isolation, together with fittings and appurtenances, shall be furnished on all high and low pressure taps.

D. Accuracy shall be + or - 0.50% of actual flow rate over the specified flow range. Permanent head loss shall not exceed 8% of the maximum differential pressure.

E. Sizing of all the insert flow tubes for airflow shall be based on a pressure of 10.5 psig and a temperature of 175°F.

F. The flow tubes shall be Model HVT-PS as manufactured by Primary Flow Signal, Inc., or equivalent by Badger Meter, BIF Products, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. All insert venturi meters and appurtenant work, including pressure taps, shall be installed in strict accordance with the manufacturer's printed instructions.

B. Refer to Section 17600, Part 3 for additional requirements.

END OF SECTION

SECTION 17650

PRESSURE GAUGES

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SECTION 17650

PRESSURE GAUGES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17600 - *Unpowered Instruments - General.*

C. Section 17698 - *Instrumentation Accessories.*

PART 2 – PRODUCTS

2.1 PRESSURE GAUGES

A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.

C. Features:
1. Mounting: ½" NPT, lower stem mount type
2. Accuracy: +/- 0.5% full scale
3. Case: Solid front, black phenolic material
4. Dial: 4-1/2" diameter dial size, white background and black letters
5. Glass: Shatterproof
6. Blow-out protection: Back
7. Pressure element: stainless steel bourdon tube
8. Movement: Stainless steel, Teflon coated pinion gear and segment
9. Gaskets: Buna-N

D. Liquid-filled gauges shall be used if the gauges are installed on the discharge side of positive displacement pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be glycerin.

E. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 17698 - Instrumentation and Control System Accessories. Gauge size shall be 2" for line sizes up to 3" and 4½" for line sizes of 4" or greater.

F. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.

G. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17600, Part 3.

END OF SECTION

SECTION 17675

PRESSURE SWITCHES

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SECTION 17675

PRESSURE SWITCHES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17600 - *Unpowered Instruments - General.*

PART 2 – PRODUCTS

2.1 PRESSURE SWITCHES

A. Pressure, vacuum, and differential pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated and activate S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.

B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by ASCO, SOR, Inc., Ashcroft, or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17600 Part 3.

END OF SECTION

SECTION 17698

INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

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SECTION 17698

INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17600 - *Unpowered Instruments - General.*

C. Section 17700 - *Powered Instruments - General.*

PART 2 – PRODUCTS

2.1 INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

A. General: Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This subarticle shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.

B. Process Tubing: Process tubing shall be 1/2 x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with Type 316 - 37 degrees stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.

C. Power, Control and Signal Cables: Power, control and signal wiring shall be provided under Division 16 of the Specifications.

D. Chemical Diaphragm Seals: Diaphragm seals shall be provided to systems as shown on the Contract Drawings and/or as specified herein for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, seals shall be of all 316 stainless steel construction. In general, diaphragms shall be 316L stainless steel for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, diaphragm material shall be non-reactive with the process fluid in all cases. Refer to the Instrument Schedules for specific materials requirements. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries. Seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equal.

E. Isolating Ring Seals: For solids bearing fluids, line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the associated pressure sensing instrument(s).

1. Full Line Size Isolating Ring Seals - For all grit/sludge/slurry/scum applications or wherever the associated pressure instrument is used for control purposes, the sensor body shall be full line size wafer design. Except where noted on the Drawings and/or Instrument Schedule, full line size ring seals will not be required for return activated sludge (RAS) lines, but will have tapped ring seals as specified in Item 2, below. Full line size isolating ring seals shall have 316 stainless steel housing and assembly flanges and Buna N flexible cylinder lining for in-line mounting. The wafer shall have through bolt

holes or centerline gauge for positive alignment with the associated flanged piping. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Isolating ring seals shall be RED Valve Series 40, Ronningen-Petter Iso-Ring, Moyno RKL Series W, or equal.

2. Tapped Isolating Ring Seals - For all other solids bearing fluids, pressure shall be sensed via a 1/2" diameter spool-type isolating ring seal mounted on a 1/2" pipe nipple at 90° from the process piping. An isolation ball valve shall be provided between the process piping and the ring seal, and a cleanout ball valve shall be provided between the ring seal and the atmosphere. The pressure instrument shall be back or side mounted to the ring seal such that the gauge or readout may be viewed normally. Tapped isolating ring seals for solids service shall be Red Valve Series 42, Ronningen-Petter Iso-Spool, or equal.

F. Filling Medium: The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10°F to +150°F.

G. Isolation Valves: Isolation valves shall be 1/2 - inch diameter ball valves with 316 stainless steel body, 316 stainless steel ball, except that materials of construction shall be suitable for the associated process fluid where applicable (i.e., chemical service).

H. Sirens: Sirens shall be UL Listed, heavy duty, AC motor driven, weatherproof type capable of producing a minimum of 111 dBA at 10 feet. Power supply shall be 120 VAC, 60 hertz. Siren shall be McMaster-Carr Model 6392T11, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or equal.

I. Strobe Lights: Strobe lights shall be high profile with Type 304 stainless steel base. Light is rated NEMA 4. Light shall have an outer dome to provide extra lens protection. Lens color shall be as indicated on the Drawings. Surface mount hardware shall be included. Power supply shall be 120 VAC, 60 hertz. Strobe light shall be McMaster-Carr Model 5848T71, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17600, Part 3 of the specifications.

END OF SECTION

SECTION 17700

POWERED INSTRUMENTATION - GENERAL

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SECTION 17700

POWERED INSTRUMENTATION - GENERAL

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The instrumentation subcontractor shall furnish, install, test and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments that require power (120 VAC or 24 VDC loop power) to operate. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17500 - *Enclosures - General.*

C. Section 17600 - *Unpowered Instruments - General.*

D. Section 17698 - *Instrumentation and Control System Accessories.*

E. Section 17800 - *Analytical Instruments - General.*

F. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.3 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050.

B. In addition to the above requirements, the instrumentation subcontractor shall provide one remote handheld configuration device for communication with all "smart" instruments furnished under this Contract. The devices shall be capable of performing configuration, test, and format functions from anywhere on the 4-20 mA signal loop for a particular transmitter or by direct connection. The configuration device shall be Fischer & Porter Model 50HC1000, Rosemount Model 375, or equal.

PART 2 – PRODUCTS

2.1 GENERAL

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.

C. All field instrumentation for outdoor service shall be provided with enclosures which are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.
2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 17520, Field Panels, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.

D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.

F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass or PVC coated copper-free cast aluminum NEMA 4X construction.

G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.

L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

PART 3 — EXECUTION

3.1 INSTALLATION

A. General:

1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support:

1. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be schedule 40, 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring:

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.2 ADJUSTMENT AND CLEANING

A. General:

1. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
2. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's

specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

B. Field Instrument Calibration Requirements:

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
2. If the manufacturer's recommendations require calibration, each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

END OF SECTION

SECTION 17701

MAGNETIC FLOW METERS

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SECTION 17701

MAGNETIC FLOW METERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17700 - *Powered Instruments - General.*

1.3 TOOLS, SUPPLIES AND SPARE PARTS

A. Furnish one portable primary head simulator for calibration and testing of magnetic flowmeter signal converters. The calibrator shall be furnished complete with rechargeable battery pack, test leads, spare battery pack, charger, carrying case and accessories. Calibrator shall be furnished by the flowmeter manufacturer, and shall be fully matched to the instrumentation furnished.

PART 2 – PRODUCTS

2.1 MAGNETIC FLOW METER SYSTEMS

A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. The magnetic flow meter shall be suitable for full pipe flow measurement with uni-directional flow. The flow tube shall use a spool piece configuration with field-interchangeable sensors containing coils and electrodes. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

B. The spool piece flow tube shall be made of carbon steel and shall be powder coated with a corrosion resistant electrostatic epoxy finish inside and outside, and shall include Type 316 stainless steel bolts. O-ring seals shall be made of Viton, and standpipe gaskets shall be made of nitrile rubber.

1. Flow tubes shall be furnished with Teflon liners for chemical service. Accuracy shall be not be affected by cuts or scratches in the flow tube liner.
2. The flow tube shall be supplied with raised face carbon steel flanges to ANSI 150.

C. Each flow sensor shall contain a coil, a pair of sensing electrodes, and an integral grounding electrode. External grounding rings and straps shall not be necessary. The sensors shall use solid state design, with the coils, electrodes, and other sensor components encapsulated in Kynar. The sensors shall be field-replaceable and field-interchangeable without the need for re-calibration.

D. All materials of construction for metallic wetted parts (electrodes, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer. For sodium hypochlorite service, all metals shall be avoided except titanium, tantalum and platinum.

E. The sensors shall use unipolar pulsed electromagnetic excitation, with typical magnetizing current of not less than 2 to 5 A peak to peak, coil voltage of not less than 80 V, and frequency of not less than 2/3 of power supply frequency (40 Hz for a 60 Hz power supply

frequency), and capable of a quality factor (magnetizing current in amps peak to peak times frequency in Hz to the 3/2 power) of 500 to 1260 to ensure a high signal-to-media noise ratio.

F. The minimum media conductivity shall be 0.5 microS/cm.

G. The maximum media temperature shall be 175 degrees F (80 degrees C).

H. The flow meter shall include multiple sensors to measure mean velocity in full pipes.
   1. The mean velocity measurement range shall be from 0 to 2 feet per second (0 to 0.6 meters per second) to 0 to 50 feet per second (0 to 15 meters per second).
   2. The minimum detectable mean velocity shall be 0.02 feet per second (0.006 meters per second).
   3. The mean velocity shall be measured with a maximum error of +/-0.005 feet per second (+/- 0.0015 meters per second) over a range of less than 1 foot per second (0.3 meters per second), and +/-0.5% of flow rate over a range of 1 to 50 feet per second (0.3 to 15 meters per second). A mean velocity of 0.1 foot per second (0.03 meters per second) shall be measured with a maximum error of +/-5% of flow rate. Accuracy shall be traceable to the US National Institute of Standards and Technology (NIST), and shall be guaranteed on-site for applications such as drinking water, raw sewage, and similar media, even with a permanent coating of raw sewage or similar on the electrodes, provided that specification parameters and installation recommendations are met. A NIST traceable calibration certificate shall be provided with each flow meter.
   4. The temperature coefficient shall be less than 0.05% per 10 degrees F (0.09% per 10 degrees C).
   5. The flow transmitter shall use the electrodes on the sensors, or a user-supplied signal into a contact input on the flow transmitter, to detect a non-full pipe condition. When a non-full pipe condition occurs, the 4 to 20 mA output on the flow transmitter shall go to 4 mA, the pulse frequency output and totalizer shall stop, and a relay in the flow transmitter shall be activated.
   6. Maximum pressure shall be 150 psi (10 bar).

I. The wiring from the flow transmitter to the sensors shall be 3 separate 2-conductor cables, 18 gauge (0.75 mm^2), twisted and shielded.

J. The flow tube and sensors shall be permanently submersible to NEMA 6P (IP68) to 33 feet (10 m).

K. The flow transmitter shall contain an 8 digit liquid crystal display (LCD) with characters 0.38 in. (10 mm) high and 0.19 in. (5 mm) wide, and a keypad. The LCD shall display a 4 to 5 digit flow rate, scaled for any units of measure. The flow transmitter shall have the capability to dampen the flow rate display to provide an average value of readings over a selectable time interval from 0.15 to 60 seconds. The LCD shall display an 8 digit total flow, resettable or non-resettable, scaled for any units of measure. The keypad shall include buttons to switch between display of flow rate and total flow, and to reset the totalizer.

L. The flow transmitter shall include a rotary switch for zero test and span tests.

M. The flow transmitter shall have an input impedance of 10^{12} ohms with driven shield capability.

N. The flow transmitter shall include an isolated 4 to 20 mA output signal based on flow rate into a maximum of 800 ohms. The flow transmitter shall have the capability to dampen the 4 to 20 mA to provide an average value of readings over a selectable time interval from 0.15 to 60 seconds.

O. The flow transmitter shall include a pulse frequency output based on flow rate, selectable from 0 to 5,000 Hz to 0 to 10,000 Hz, optically isolated, rated 30 volts DC, 50 mA.

P. The flow transmitter shall include isolated relay contacts, form-C activated based on minimum or maximum flow rate, and form-C activated based on non-full pipe detection, rated 125 volts AC, 1 A, 30 VA, and optically isolated, activated based on reverse flow, rated 30 volts DC, 50 mA.

Q. The flow transmitter shall operate on 120 VAC, 50/60 Hz line power. Typical power consumption shall be 10 W, including the sensors. The flow transmitter shall include a +/- 15 VDC, 10 mA output to power the preamplifier on the flow tube.

R. The flow transmitter shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (NEMA 4X and IP65) cast aluminum, fusion bonded epoxy enamel painted enclosure suitable for conduit connections.

S. Magnetic flow meter systems shall be UniMag Series as manufactured by Advanced Flow Technology Company (AFTCO).

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17700, Part 3.

END OF SECTION

SECTION 17740

ULTRASONIC LIQUID LEVEL MEASUREMENT SYSTEMS

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SECTION 17740

ULTRASONIC LIQUID LEVEL MEASUREMENT SYSTEMS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the ultrasonic liquid level measurement systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17700 - *Powered Instruments - General.*

PART 2 – PRODUCTS

2.1 ULTRASONIC LEVEL CONTROLLERS

A. Each ultrasonic level monitoring system shall include one ultrasonic level sensor and an "intelligent" transmitter (controller). The ultrasonic level monitoring system shall be required to monitor the level of liquids as shown on the Drawings and/or as specified herein. Location of the sensor and transmitters shall be as shown on the Drawings and/or as specified.

B. For outdoor installation, the use of approved watertight conduit hub/glands shall be required. Tank mounting applications shall include mounting flange adapter supplied by the manufacturer, which is compatible with the process liquid and the tank flange connection. Sensor mounting thread shall be 1" NPT. Channel or wall mounting applications shall include mounting bracket supplied by the manufacturer and constructed of 316 stainless steel material.

C. The level sensor shall be unaffected by moisture droplets on the transducer face and operate on the ultrasonic echo ranging principle. Sensor accuracy shall be a minimum of 0.25 percent of level measurement range, and include integral temperature compensation with an accuracy of 0.01% per °C. Resolution shall be at least 0.1 percent of full range or 0.08 inches, whichever is greater.

D. The transmitter shall be programmable with a LCD display, which shall have the capability to display a minimum of 4 characters at one time, and shall be shielded from direct sunlight. The transmitter shall compensate for temperature and air density. The controller shall be capable of performing the following functions: level monitor, both linear and nonlinear level to flow relationships, volumetric, level signals, control of up to 5 pumps, alarms, monitor pump runtime and pump sequencing. Output level signal shall be linear, isolated 4-20 mA DC. Power requirement for the transmitter shall be 120 VAC, 60 Hz. The units shall have a NEMA 4X stainless steel or nonmetallic enclosure. The units shall have as a minimum, the required number of programmable set points to perform the functions specified. Each set point shall operate a set of contacts rated at 10 amps, 120 VAC.

E. Ultrasonic level measurement system shall be the HydroRanger 200/Echomax Series Transducers by Siemens/Milltronics, or equal.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Where level transducers may become submerged, provide a manufacturer-supplied submergence hood.

B. For open channel flow applications where the transducer is subject to direct sunlight, use an externally mounted temperature compensator mounted out of direct sunlight.

C. Refer to Section 17700, Part 3 of the specifications for additional requirements.

END OF SECTION

SECTION 17760

PRESSURE INDICATING TRANSMITTERS

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SECTION 17760

PRESSURE INDICATING TRANSMITTERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure indicating transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - *Control and Information System Scope and General Requirements.*

B. Section 17700 - *Powered Instruments - General.*

PART 2 – PRODUCTS

2.1 GAUGE PRESSURE INDICATING TRANSMITTERS

A. Gauge pressure transmitters shall be of the capacitance type with a process-isolated diaphragm with silicone oil fill, microprocessor-based "smart" electronics, and a field adjustable rangeability of 100:1 input range. Span and zero shall be continuously adjustable externally over the entire range. Span and zero adjustments shall be capable of being disabled internally. Transmitters shall be NEMA 4X weatherproof and corrosion resistant construction with low-copper aluminum body and 316 stainless steel process wetted parts. Accuracy, including nonlinearity, hysteresis and repeatability errors shall be plus or minus 0.065 percent of calibrated span, zero based. The maximum zero elevation and maximum zero suppression shall be adjustable to anywhere within sensor limits. Output shall be linear isolated 4-20 milliamperes 24 VDC. Power supply shall be 24 VDC, two-wire design. Each transmitter shall be furnished with a 4-digit LCD indicator capable of displaying engineering units and/or milliamps and mounting hardware as required. Overload capacity shall be rated at a minimum of 25 MPa. Environmental limits shall be -40 to 85 degrees Celsius at 0-100% relative humidity. Each transmitter shall have a stainless steel tag with calibration data attached to body.

B. The piezo-resistive silicon pressure sensor shall be mechanically, electrically, and thermally isolated from the process and the environment, shall include an integral temperature compensation sensor, and shall provide a digital signal to the transmitter's electronics for further processing. Factory set correction coefficients shall be stored in the sensor's non-volatile memory for correction and linearization of the sensor output in the electronics section. The electronics section shall correct the digital signal from the sensor and convert it into a 4-20 mA analog signal for transmission to receiving devices. The electronics section shall contain configuration parameters and diagnostic data in non-volatile EEPROM memory and shall be capable of communicating, via a digital signal superimposed on the 4-20 mA output signal, with a remote interface device. Output signal damping shall be provided, with an adjustable time constant of 0-36 seconds. Total long-term stability (frequency of calibration) shall be not less than 0.125% for five years.

C. Where scheduled, gauge pressure indicating transmitters shall be calibrated in feet of liquid for liquid level service.

D. Gauge pressure indicating transmitters shall be Model 3051T as manufactured by Rosemount, or equal.

2.2 DIFFERENTIAL PRESSURE INDICATING TRANSMITTERS

A. Differential pressure indicating transmitters shall be the same as the gauge pressure transmitters except for body specifications. Differential pressure units shall be furnished with close coupled stainless steel three valve manifold assembly. Manifold assembly shall be HEX Products Model HM, or equal.

B. The electronics sections of differential pressure transmitters shall contain user-selectable square root extractors to provide a linear 4-20 mA DC output proportional to flow, when activated. Square root extractor circuitry shall be activated on the flow transmitters listed in the Instrument Schedules. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter.

C. Differential pressure indicating transmitters shall be Model 3051C as manufactured by Rosemount, or equal.

2.3 FLANGE MOUNTED LEVEL INDICATING TRANSMITTERS

A. Flange-mounted tank liquid level indicating transmitters shall be the same as gauge pressure transmitters except for body type.

B. The flange-mounted sensor shall consist of a special non-corrosive isolating diaphragm with fill fluid in a sealed capillary system to transmit liquid pressure to the sensing element. A second isolating diaphragm shall transmit pressure through the fill fluid to the sensing diaphragm in the center of the capacitance cell. An isolating diaphragm and fluid fill shall also be provided on the opposite side of the sensing diaphragm to convey atmospheric or reference pressure.

C. All mounting flanges, diaphragms, O-rings and materials used in construction shall be non-corroding, compatible with each other, and compatible with the liquid being measured.

D. Flange-mounted liquid level transmitters shall be as manufactured by Rosemount, Model 3051L.

PART 3 – EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 17700, Part 3 of the Specifications.

END OF SECTION

SECTION 17800

ANALYTICAL INSTRUMENTS

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SECTION 17800

ANALYTICAL INSTRUMENTS

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The instrumentation subcontractor shall furnish, install, test and place in operation the analytical instruments as indicated and specified together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with the process control system as shown on the Drawings and as specified. The Contractor may elect to install sensors on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated indicators, sensors, sampling pumps, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Section where installation is provided by others.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the analytical instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instruments furnished under this Section are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at <u>all</u> process taps.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 — Control and Information System Scope and General Requirements.

1.3 TOOLS, SUPPLIES AND SPARE PARTS

A. Items as recommended by the analytical instrument manufacturers or as described for the specified analytical instrument sections shall be provided.

PART 2 — PRODUCTS

2.1 GENERAL

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.

C. All field instrumentation for outdoor service shall be provided with enclosures that are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.

2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 17520, Field Panels, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.

D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 B herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.

F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass (or equivalent) or PVC coated copper-free cast aluminum NEMA 4X construction.

G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.

L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

2.2 ANALYSIS INSTRUMENTS

A. Liquid samples shall not pass through housings containing analyzer electronics. Process fluid temperature will be within a range of 40 to 90 degrees F.

B. Where ambient temperatures will affect accuracy by more than 1 percent of span, a suitable isothermal enclosure with thermostatically controlled space heater shall be provided.

C. Sample assemblies shall be suitable for submersion or flow-through service as noted and shall be chemically inert to constituents of raw wastewater solids or other chemical

environment, as scheduled. Where the sample is drawn prior to filtration, the sample assemblies shall be capable of handling solids and grease.

D. Each analyzer requiring reagents and/or other replaceable parts shall be furnished with sufficient chemicals and replaceable parts for startup and acceptance tests and the specified warranty period.

E. Contractor's submittals on these analyzers shall include information on monthly reagent consumption and a list of replaceable parts required for periodic maintenance and the recommended operating periods between replacements. Installation of analyzers and sample preparation shall be in accordance with the analyzer manufacturer's instructions.

F. Analysis instrumentation performance, accuracy and reproducibility shall be as prescribed in APHA/AWWA/WEF "Standard Methods for the Examination of Water and Wastewater", latest edition. For those measurements specified herein, for which performance characteristics are not listed in the above, the supplier shall state instrument performance characteristics. The "referee" method shall be as prescribed in EPA Methods for Chemical Analysis of Water and Wastes (1971).

2.3 PH INSTRUMENTS

A. Furnish and install the following pH instruments:

TAG	SERVICE	PROBE TYPE	RANGE
AIT 1	Middle Fork Raw Water	Flow-through	0-14 pH
AIT 2	South Fork Raw Water	Flow-through	0-14 pH
AIT 3	Pre Static Mixer	Flow-through	0-14 pH
AIT 4	Post Static Mixer	Flow-through	0-14 pH
AIT 5	Filter Influent Channel	Immersion	0-14 pH
AIT 6	Filter Effluent	Flow-through	0-14 pH
AIT 7	Finished Water	Flow-through	0-14 pH

B. pH instruments shall be Hach type P53, approved equal, with probes as shown above.

C. Provide probe cables installed in conduit.

2.4 HIGH RANGE TURBIDIMETERS

A. Furnish and install the following high turbidimeters:

TAG	SERVICE	TYPE	RANGE
TM-1	Middle Fork Raw Water	Surface Scatter	0 – 1000 NTU
TM-2	South Fork Raw Water	Surface Scatter	0 – 1000 NTU
TM-3	Combined Raw Water	Surface Scatter	0 – 1000 NTU

B. The method of measuring turbidity shall be by detection of 90-degree scattered light from particles in the sample.

C. System Accuracy:
   1. Performance Requirements:
      a. Measurement range: 0 to 9999 Nephelometric Turbidity Units (NTU).
      b. Accuracy:
         1) From 0 to 2000 NTU: ±5% of reading or ±0.1 NTU (whichever is greater).
         2) From 2000 to 9999 NTU: ±10% of reading.
      c. Resolution:
         1) Below 100 NTU: 0.01 NTU.
         2) Between 100 to 9999.9 NTU: 0.1 NTU.

d. Repeatability: 1.0% or ±0.04 NTU, whichever is greater.
e. Response time: Initial response in 45 seconds.

D. Environmental Requirements:
1. Operational Criteria:
a. 32 to 122°F.
b. Sample flow required:
1) 1.0 to 2.0 L/min (15 to 30 GAL/HR).

E. Manufacturer:
1. Hach Company.
a. Model Surface Scatter 7 sc Turbidimeter.

F. Manufactured Unit:
1. The Surface Scatter Turbidimeter shall consist of:
a. Turbidimeter.
b. Hach sc100 Controller.

G. Equipment Design:
1. The Turbidimeter shall be a continuous-reading instrument.
2. All optical and hydraulic components shall be housed in the sampling unit.
3. C. The sampling unit shall be housed in a NEMA-12 industrial plastic enclosure.
4. Control unit:
a. The control unit shall be equipped with linear output signal that can be programmed to span all or any portion of the 0 to 9999 NTU range.
b. Turbidity alarm set points shall be adjustable over the entire range of the instrument with a SPDT relay with unpowered contacts rated for 6 A.
c. The control unit shall be housed in a NEMA-4X industrial enclosure.

2.5 LOW RANGE TURBIDIMETERS

A. Furnish and install the following low range turbidimeters:

TAG	SERVICE	TYPE	RANGE	NOTES
TM-4	Sed Basin 1 Effluent	Immersed Sensor	0 – 10 NTU	
TM-5	Sed Basin 2 Effluent	Immersed Sensor	0 – 10 NTU	
TM-6	Sed Basin 3 Effluent	Immersed Sensor	0 – 10 NTU	
TM-7	Combined Pre Sed Effluent	Immersed Sensor	0 – 10 NTU	
TM-8	AC-1 Effluent	Immersed Sensor	0 – 10 NTU	
TM-9	AC-2 Effluent	Immersed Sensor	0 – 10 NTU	
TM-10	AC-3 Effluent	Immersed Sensor	0 – 10 NTU	
TM-11	Combined AC Effluent	Immersed Sensor	0 – 10 NTU	
TM-12	Filter 1 effluent	Immersed Sensor	0 – 2 NTU	Existing
TM-13	Filter 2 effluent	Immersed Sensor	0 – 2 NTU	Existing
TM-14	Filter 3 effluent	Immersed Sensor	0 – 2 NTU	Existing
TM-15	Filter 4 effluent	Immersed Sensor	0 – 2 NTU	Existing
TM-16	Filter 5 effluent	Immersed Sensor	0 – 2 NTU	
TM-17	Filter 6 effluent	Immersed Sensor	0 – 2 NTU	
TM-18	Filter 7 effluent	Immersed Sensor	0 – 2 NTU	
TM-19	Filter 8 effluent	Immersed Sensor	0 – 2 NTU	
TM-20	Combined Filter Effluent	Immersed Sensor	0 – 2 NTU	
TM-21	Finished Water	Immersed Sensor	0 – 2 NTU	

B. The turbidimeter shall measure turbidity in the range of 0.001 to 100 NTU and shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument meeting all design and performance criteria specified by USEPA method 180.1.

C. Light shall be directed through the surface of the sample and the detector shall be immersed in the sample, eliminating glass windows and flow cells. Optical components shall be mounted in a sealed head assembly that can be removed easily for calibration/service, without disturbing sample flow. The turbidimeter body shall be constructed of corrosion-resistant polystyrene, and shall include an internal bubble removal system to vent entrained air from the sample stream.

D. Accuracy shall be ±2% of reading or ±0.015 NTU (whichever is greater) from 0 to 40 NTU; ±5% of reaching from 40 to 100 NTU. Displayed resolution shall be 0.0001 NTU from 0 to 9.9999 NTU; 0.001 NTU from 10.000 to 99.999 NTU and repeatability shall be better than ±1% of reading or ±0.002 NTU (whichever is greater). User selectable signal averaging, bubble removal, alarm and recorder output hold, and self-test diagnostics shall be provided.

E. Serial communication to a computer shall provide downloading capability of turbidity data, calibration history, and current set.

F. The interface unit shall allow operators to control sensor and interface functions with user-friendly, menu-driven software, and shall provide data logging of measurement data from up to two turbidimeters for 15 minutes, 1 hour, 24 hours, 30 days, or 180 days and the capability to transfer data to a computer or printer via direct MODBUS communications or directly into a Personal Digital Assistant (PDA) via a wireless IR Port. The interface unit will also have a built-in data logger with the storage capacity to store data on 15-minute intervals for up to 6 months with two sensors per controller.

G. Each interface will also include two analog outputs and 3 un-powered SPDT alarm contacts. The interface unit and the DC power supply shall be housed in a NEMA-4X industrial metal/plastic enclosure. The power supply shall automatically accept input in the range of 100 to 230 VAC, 50/60 Hz.

H. Turbidimeters shall be Hach Model 1720E.

I. Provide Hach model SC100 digital controller with each turbidimeter with interconnecting cable.

J. Provide Hach bubble trap per Hach drawing 46680-98 mounted to factory aluminum stand for bolting to concrete floor. Mount and connect turbidimeter on this stand above the bubble trap.

2.6 FLUORIDE ANALYZER

A. Provide one process analyzer for continuous monitoring of fluoride in water.

B. The method of measuring fluoride shall be with ion-selective electrode (ISE) method using total ionic strength adjustment buffer (TISAB) reagent and two fluoride standards.

C. Performance Requirements:
1. Measurement range: 0.1 to 10 mg/L fluoride.
2. Accuracy: ±10% or ±0.10 ppm whichever is greater.
3. Precision: ±7% or ±0.07 ppm whichever is greater.
4. Minimum detection limit: 0.10 mg/L.
5. Cycle time: 4.2 minutes.

D. Operational Criteria:
1. Operating temperature: 5 to 40°C (41 to 104°F).
2. Operating humidity: 90% at 40°C (90% at 104°F) maximum.
3. Sample temperature: 5 to 40°C (41 to 104°F).
4. Sample flow rate: 200 to 500 mL/MIN (200 mL/MIN minimum required).
5. Sample inlet pressure: I to 10 psig (use sample restriction device to reduce higher pressure samples).

6. Sample size: 0.3 mL.

E. Fluoride analyzer shall be Hach Company model CA610 Fluoride Analyzer with ABS, IP62 rated plastic enclosure with two clear polycarbonate windows for viewing the measurement readout and reagent levels.

F. The CA610 fluoride analyzer shall operate unattended for 30 days and use less than 500 mL of reagent per month and less than 500 mL each of two standard solutions every two months when the calibration interval is set for 24 hours.

G. Fluoride results shall be displayed by a three-digit menu-driven LCD readout.

H. The analyzer shall be equipped with the following communications capabilities:
   1. One optically isolated analog output selectable over 4-20 mA. The output span is field-programmable over any portion of the analyzer range allowing the readings to be available for a recorder, PLC, or SCADA.

I. Four internal alarms including two concentration set point alarms, analyzer system warning and analyzer system shut-down alarm. Each alarm is user-selectable for:
   1. Sample concentration alarms fully adjustable through the entire range.
   2. System warnings (activate for minor variations in analyzer performance).
   3. System alarms (activate for major variations in analyzer performance and will shut down the analyzer until corrective action is taken).

J. Two SPDT normally-open/normally-closed dry-contact relays rated at 5 A resistive load at 230 VAC.

K. Power requirement is 100-115/230 VAC, switch selectable, 50/60 Hz,90 VA maximum, with 2.5 A fuse.

PART 3 — EXECUTION

3.1 INSTALLATION

A. General:
   1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
   2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support:
   1. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
   2. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
   3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
   4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring:
   1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.2 ADJUSTMENT AND CLEANING

A. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

D. Field instrument calibration shall conform to the following requirements:
   1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
   2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments and specified chemicals of known values to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
   3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
   4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
   5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

END OF SECTION

SECTION 17950

FUNCTIONAL CONTROL DESCRIPTIONS

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SECTION 17950

FUNCTIONAL CONTROL DESCRIPTIONS

PART 1 — GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.

B. Together with the control system input/output drawings, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. THE FUNCTIONAL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.

D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.

E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the functional descriptions as required providing all functions specified herein shall be furnished by the Electrical Contractor under Division 16. The Electrical Contractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 11025 - *Filter Units.*

B. Section 11227 - *Adsorption Clarifiers.*

C. Section 11240 - *Chemical Transfer and Metering Pumps.*

D. Section 11930 - *Chlorine Vapor Scrubber System.*

E. Section 11921 - *Chemical Feed: Chlorine.*

PART 2 — FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

2.1 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as over torque, over temperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

2.2 CONVENTIONS

A. Operator workstation graphic display symbols and indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

Condition	Color
Running/On/Open	Red
Auto/Ready	White
Stopped/Off/Closed	Green
Fail/Alarm	Amber
Generic Status	Blue or White

2.3 PROCESS CONTROL

A. Where set points, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions; the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For alarms and control actions derived from analog input signals, use adjustable time delays and dead bands.
2. For alarms and control actions derived from discrete input signals, use adjustable time delays.
3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for dead bands shall be 5% of span (range 0-100%).
4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. All set point control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All set points, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.

D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

F. Equipment failure shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

G. Instrument failure shall be generated via the operator work stations for any instrument which is generating a signal which is less than 4 mA or greater than 20 mA.

H. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

I. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

PART 3 — FUNCTIONAL CONTROL DESCRIPTIONS

3.1 GENERAL REQUIREMENTS

A. The contractor shall assign the responsibility of PLC programming for the adsorption clarifier controls to the manufacturer of the adsorption clarifier. This includes programming of PLC-4 and PLC-5, and the associated Operator Interface Panels.

B. The contractor shall assign the responsibility of PLC programming for the filter controls to the manufacturer of the filters. This includes programming of PLC-2 and PLC-3, and the associated Operator Interface Panels.

C. The contractor shall assign the responsibility for the plant SCADA system programming to the Systems Integrator. This includes PLC-1, PLC-6, PLC-7, PLC-8, PLC-9, and PLC-10, and the two SCADA computers. The Systems Integrator shall also be given the responsibility to coordinate his display, control, trending, and data logging with the adsorption clarifier manufacturer and the filter manufacturer.

D. Refer to drawings E001, E002, and E003. These drawings indicate discrete inputs, discrete outputs, analog inputs, and analog outputs connected to the PLC shown.

1. Discrete inputs shall be displayed on the Operator Interface Computer (OIC) screens as status or alarm points, as applicable.
2. Discrete outputs shall control equipment as described in part 3 of this specification.
3. Real-time trends, historical trends, and digital value displays shall be configured in the OIC and displayed for analog signals. Flow signals shall be totalized and stored in retentive memory. Instantaneous values of pressure, loss-of-head, turbidity, flow, and levels shall be logged to the hard disk each 15 seconds.
4. Analog outputs shall control equipment as described in part 3 of this specification.
5. Pumps shall have HAND/OFF/AUTO switches configured on the OIC screens.
6. Motor operated valves shall have HAND/OFF/AUTO switches and manual OPEN/CLOSE switches configured on the OIC screens. For modulating valves, provide a manual positioning control on the OIC screens, active when the switch is in HAND.
7. Alarms that are generated by PLC control panels, equipment control panels, and Variable Frequency Drives shall be displayed at each OIC. Refer to approved shop drawings and wiring diagrams for the above equipment.
8. Pump, filter, and adsorption clarifier run times shall be totalized.

E. The SCADA system shall record the finished water free chlorine residual (determined by the existing inline monitor) and the various required pH results determined by the required inline pH meters every 15 minutes in accordance with continuous monitoring requirements of the *Waterworks Regulations*.

3.2 MIDDLE FORK RAW WATER PUMPS

A. Pumps at the Middle Fork Raw Water Pump Station selected to run are manually started and speeds are manually set to the desired raw water flow.

3.3 SOUTH FORK RAW WATER PUMPS

A. Pumps at the South Fork Raw Water Pump Station selected to run are manually started and pump speeds are manually set to the desired raw water flow.

3.4 SOUTH FORK RAW WATER CONTROL VALVE

A. The south fork raw water control valve is automatically positioned to maintain the inlet pressure to the control valve as required to keep the water level in the gravity inlet pipe near the highest elevation of the pipe.

3.5 RAW WATER FLASH MIXERS

A. Flash mixers are manually started and the speed is manually set.

3.6 FLOCCULATORS

A. Flocculators are manually started and the speed is manually set.

3.7 SEDIMENTATION BASINS

A. The level in each sedimentation basin is measured. Low and high level alarms allow the operator to adjust raw water flow if necessary.

B. The level in each sedimentation basin effluent trough is measured. Low and high level setpoints provide control actions as described below. A selector switch provides for manual selection of the level transmitter to be used for control.

3.8 INTERMEDIATE BOOSTER PUMP STATION

A. Booster pumps are variable speed operating on VFD's. In AUTO as selected at the VFD, speed is automatically controlled by the level in the filter influent channels. The level transmitter used for control can be selected.

B. Speed control is implemented with a PID controller configured in PLC software.

C. Pumps shall automatically stop if low level is detected in the sedimentation effluent trough. Manual reset is required to enable automatic pump operation.

3.9 ADSORPTION CLARIFIERS

A. Influent flow is automatically controlled by a modulating inlet valve. The operator selects the flow to be automatically maintained by a PID controller configured in PLC software.

B. Inlet flow and loss-of-head is measured.

C. The clarifier control shall provide means for automatically initiating a flush cycle for each adsorption clarifier by a time clock or preset adjustable clarifier headloss pressure switch. An interlock shall be provided so that only one unit can be flushed at a time. A selector switch shall provide override of the automatic flush initiation to allow manual flushing of each unit. During the flush cycle, collected solids shall be removed by proper sequencing of valves of the blower. Return to service shall be automatic. Controls shall allow operator-preset flushing flowrate.

D. The control system shall accept from the Plant SCADA system the plant flowrate and shall automatically distribute flow to the three adsorption clarifiers in the most efficient manner but loading shall not exceed operator preset flowrate, initially set at 4.6 MGD. The control system shall automatically redistribute flow when one clarifier is taken out of service without causing pressure surges or loading any clarifier above the preset flow rate.

E. Comply with other control and monitoring requirements in specification Section 11227 - Adsorption Clarifiers.

3.10 FILTERS

A. Filter effluent flow is automatically controlled by the modulating effluent valve to maintain the operator entered setpoint. Effluent flow control is implemented by a PID controller configured in PLC software.

B. General:

1. All filters will be automated and integrated into a common PLC control system and will function as typically described for Filter 1.

2. Filter run time will be monitored and totalized by the PLC. A filter will be considered to be on-line if its influent valves are full open and its effluent valve is at least partially open.
3. Filters will be selected for operation by the operator at the computer. The quantity of filters required will be calculated by the operator or the PLC based on the plant flow setpoint.
4. The flow setpoints to the individual filters will be calculated either in the PLC as the quotient of the plant influent flow divided by the quantity of filters on-line or a set flow rate shall be maintained with any variation in flow rate handled by the overflows. The option to automatically adjust setpoints to compensate for filters in backwash shall be provided. The maximum filter effluent flow setpoint shall not exceed 1340 GPM under any circumstances.
5. The filter effluent flow valves shall be adjusted to maintain a constant water level in the filter influent channel, using an operator adjustable set point. When a filter is in backwash, filter operation may not keep up with the influent flow depending on how the filters are controlled.and the level in this channel will rise. At that point, the booster pump station to the adsorption clarifiers will slow down, allowing water to rise in the sedimentation basin and the influent flow to the filters will be reduced.
6. All automated filter valves will have motorized actuators controlled by integral reversing starters. All valves will be power-to-open/power-to-close, two position service except the filter effluent valves which will be modulated by 4-20 mA signals. All valves will have full open/full closed limit switches monitored by the PLC.
7. Each filter effluent valve will be controlled by a PLC programmed PID algorithm with 4-20 mA output to modulate the respective valve to maintain setpoint.
8. All filter valves will further have programmed override to force closure on any of the following:
    a. Filter deselected for operation at computer.
    b. As required during backwash sequence.
9. Each filter will be equipped with an effluent flow meter, effluent turbidimeter, and loss of head transmitter, with all signals input to the PLC.
10. Filter status will be tabulated on a computer filter summary screen and schematically displayed on individual filter graphic screens. The graphics will also be displayed on the respective operator interface terminal (OIT) at each filter console.

C. Filter Backwash:
1. The filter automatic backwash sequence will be PLC controlled and may be initiated by one of the following events:
    a. Operator directed start.
    b. Elapsed time since last backwash (if enabled).
    c. High headloss (if enabled).
    d. High turbidity (if enabled).
2. All filters will use the same preprogrammed sequence but only one filter will be permitted to backwash at a time.
3. A backwash setup screen will be configured at the computer or respective OIT to provide operator entry of:
    a. All adjustable time and flow setpoints.
    b. Selectively enable or disable automatic backwash initiation by elapse time, headloss, or turbidity.
    c. Select automatic return to service after backwash individually for each filter.
4. Operator directed backwash initiation will be accomplished from either the computer or the respective OIT at the filter console. Backwash progress will be displayed by step number at both computer and OIT with the capability to hold, resume, and reset in any step.
5. The backwash sequence will be programmed in each PLC.
    a. When initiated, the following steps will be automatically performed.
        1) Capture date and hour, backwash totalizer reading, elapse run time, turbidity and headloss for filter backwash daily report.
        2) Close filter influent valve and confirm.
        3) Drain filter down to programmed level.

4) Close effluent valve and confirm, zero the effluent flow setpoint.
5) Open drain valve and confirm.
6) Start backwash pump and confirm run.
7) Open air scour valve and confirm.
8) Energize air scour blower and confirm run.
9) Ramp air scour spped slowly up to preset maximum in preset amount of time (0-300s).
10) Start backwash pump against closed influent valve for 0-30 s to eliminate air.
11) Ramp backwash flow setpoint to 500 gpm (adjustable from OIT) and hold until water level reaches preset (adjustable from OIT) setpoint. This is the concurrent backwash.
12) Close air scour valve and confirm.
13) Deenergize air scour blower and confirm off.
14) Ramp backwash flow operator setpoint initially set at 4,000 gpm and hold for adjustable time (min). This is the water only backwash.
15) Ramp backwash flow setpoint to 0 gpm.
16) When backwash flow rate declines to 2,000 gpm, close drain valve and confirm.
17) Open influent valve and confirm.
18) Stop backwash pump when backwash flow rate declines to 0 gpm, confirm off.
19) Hold until filter level rises to programmed refill level.
    a) If return to service is selected, enable the filter to waste sequence (steps 20-22).
    b) If return to service is de-selected, close all valves and hold.

b. Capture the backwash totalizer reading and calculate volume used for daily report.
1) Open the filter to waste valve and confirm.
2) Hold for either a programmed time duration, or until a preset turbidity measurement is obtain, at operators option. If turbidity measurement is utilized, alarm will sound after preset amount of time.
3) Close the filter to waste valve and totalize filter to waste volume.
4) Enable the effluent valve and ramp the effluent flow setpoint to the calculated value.
5) Capture headloss and turbidity after filter to waste sequence for daily report.

6. Filter to waste sequence (steps 20-22) shall be automatically run when placing any filter on line.
7. The progress of filter backwash duration will be monitored by the PLC and compared against a benchmark duration. Excessive backwash elapsed time will be alarmed as an automatic backwash failure individually for each filter. Any singular failure will not inhibit other filter backwash, however, the affected filter will be taken off-line and held for inspection. The benchmark and elapsed time will be concurrently displayed at the computer and OIT with the capability for operator alarm override if the backwash is attended.
8. In addition to automatic backwash the operator shall have the ability to perform a manual backwash from each respective console. The backwash pump and air scour blower shall have OIT Start/Stop pushbuttons which will allow the operator to manipulate the devices individually from the touch screen when in manual mode. The operator shall also have the ability to set the backwash flow rate and blower speed for manual backwash execution.

D. Filter Operator Interface Panels (8 total):
1. Panel shall provide the following functions (through the HMI Interface):
a. Influent Valve Open/Close/Auto Switch (for both influent valves).
b. Filter Drain Valve Open/Close/Auto Switch.
c. Filter Effluent Flow Control Valve Open/Close/Auto Switch.
d. Filter-to Waste Valve Open/Close/Auto Switch.
e. Air Scour On/Off/Auto Switch.
1) Turning air switch on will result in blower slowly coming up to full speed in approximately 4 minutes.
f. Backwash Pump On/Off/Auto Switch.

1) Turning pump switch on will result in pumped flow slowly coming to preset value over 5 minutes.

g. Backwash Flow Control Valve On/Off/Auto Switch.
h. Backwash Filter Isolation Valve On/Off/Auto Switch.
i. Filter Loss of Head Display.
j. Filter Effluent Turbidity Display.
k. Effluent Flow Display, with indication of Filter to Waste or Filtered Water condition.
l. Filter water level.

E. Comply with Section 11025 - *Filter Units*.

3.11 CHEMICAL ADDITION

A. Chemical pumps listed below shall be paced to the indicated process flow. The ratio of chemical flow to process flow is set by the operator at the OIC. Chemical delivery to the system is maintained at this ratio as the process flow varies.

B. Chemical flows are measured by rotometers equipped with flow transmitters.

C. Configure PLC software for pacing the chemical feeders as shown in the table below:

Chemical	Dosing Point	Pacing Flow Signal
Fluoride	Front of CCT	Filtered Flow
Chlorine	Front of CCT	Filtered Flow
Chlorine	Filter Influent Channel	Filtered Flow
Chlorine	Static Mixer	Clarified Flow
Chlorine	Flocculation	Raw Water Flow
Chlorine	Rapid Mix	Raw Water Flow
Sodium Permanganate	Pre-Rapid Mix	Raw Water Flow
Caustic	Pre-Rapid Mix	Raw Water Flow
Polyaluminum Chloride (PACl or Coagulant)	Rapid Mix	Raw Water Flow
Polyaluminum Chloride (PACl or Coagulant)	Adsorption Clarifier	Clarified Flow
Chlorine Dioxide	Rapid Mix	Raw Water Flow
Sodium Chloride	Chlorine Dioxide Generator	Generator
Powdered Activated Carbon (PAC)	Rapid Mix	Raw Water Flow
Powdered Activated Carbon (PAC)	Static Mix	Clarified Flow
Polymer - 1	Flocculation	Raw Water Flow
Polymer - 1	Filters	Manual
Polymer - 2	Static Mixer	Clarified Flow

Filtered Flow = Sum of all active filter effluent flows.
Clarified Flow = Sum of all Clarifier flows
Raw Water = Sum of Middle and South Fork raw water flows

3.12 CHEMICAL TRANSFER TO DAY TANKS

A. The level in each chemical storage tank and day tank is measured.

B. When the day tank level drops to the low setpoint, the selected transfer pump will automatically start and fill the day tank.
1. A transfer pump start command will first open the storage tank outlet valve. When this valve is proved open, the pump will start.
2. The pump will stop and the outlet valve closed after the pump stops.
3. If the pump encounters high discharge pressure, it will stop and the valve will close. An alarm that the pump has failed will alert the operator. Manual reset of is required to enable pump operation after the high pressure alarm.

3.13 FINISHED WATER PUMPS

A. With the HAND/OFF/AUTO switch located at the Finished Water Pump VFD in AUTO, speed is manually adjusted at the OIC to produce the desired finished water flow. Typical for four finished water pumps.

B. Existing discharge check valve control shall be maintained in operation.

C. Pump speed and flow is displayed on the OICs.

D. Should low water level in the respective pump wet well occur, the pump shall stop. The resulting alarm shall be manually reset to enable pump operation.

END OF SECTION