



City of Ketchum | Sun Valley Water and
Sewer District

Ketchum - SVWSD WRF Aeration Upgrades

**Construction Documents
Project Manual – Volume 1**

Issued for Bid

January 10, 2024

HDR Project No. 10360008



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DIVISION 00



**PROCUREMENT AND CONTRACTING
REQUIREMENTS**

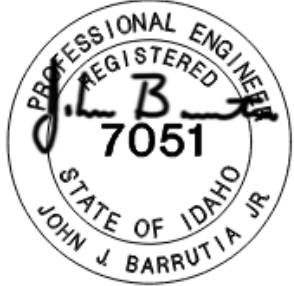


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00 01 07
SEALS AND SIGNATURES

Owner Name: City of Ketchum and Sun Valley Water and Sewer District
Facility or Site Name: Ketchum / SVWSD Water Reclamation Facility
Project Name: Ketchum / SVWSD WRF – Aeration Upgrades
Project or Contract Designation: 10360008
Engineer: HDR

<p><i>Brad Bjerke, PE</i> License No. 8778</p>  <p>01/10/2024</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 01.• Division 02.• Division 07.• Division 08.• Division 09.• Division 10.• Division 23.• Division 31.• Division 32.• Division 40.• Division 41.• Division 43.• Division 46.
<p><i>Ron Manske, PE</i> License No. 21207</p> 	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 03.• Division 04.• Division 05.• Division 06.

<p><i>John Barrutia, PE</i> License No. 7051</p>  <p>01/10/2024</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • Division 26.
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Engineer’s seal and signature does not apply to the documents that comprise Division 00, Bidding and Contracting Requirements.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this project manual.

END OF SEALS AND SIGNATURES

ADVERTISEMENT FOR BIDS

CITY OF KETCHUM AND SUN VALLEY WATER AND SEWER DISTRICT
CITY OF KETCHUM AND SUN VALLEY, IDAHO
KETCHUM / SVWSD WATER RECLAMATION FACILITY
AERATION UPGRADES

General Notice

The City of Ketchum (Ketchum) and the Sun Valley Water and Sewer District (SVWSD) (Owners) is requesting Bids for the construction of the following Project:

Ketchum / SVWSD
Water Reclamation Facility (WRF)
Aeration Upgrades

Bids for the construction of the Project will be received at Ketchum City Hall located at 191 5th Street West, Ketchum, ID 83340, until 2:00 PM MST, February 14, 2024 for receipt of Bids. At that time the Bids received will be publicly opened and read.

The Project includes the following Work:

Construction of a new room on an existing blower building to create a dedicated electrical room. Providing new electrical equipment replacing old electrical equipment, installation of Owner-Furnished Equipment (VFDs & blowers), providing submersible mixed liquor recycle (MLR) pumps, and providing floating anoxic mixers. Miscellaneous demolition including, but not limited to, existing electrical equipment, two of three existing blowers, and miscellaneous piping. Modifications to existing blower suction/discharge headers and aeration basin diffuser grids including replacement of existing diffuser elements and blank diffusers with membrane elements.

Obtaining the Bidding Documents

Information and Bidding Documents for the Project can be viewed and downloaded from the following designated website: www.ketchumidaho.org/rfps. Prospective Bidders are urged to register with the Ketchum City Clerk (tdonat@ketchumidaho.org) as a Bidding Documents holder, even if Bidding Documents are obtained from a third-party plan room or source other than the designated website in either electronic or paper format. The designated website will be updated periodically with Addenda, lists of registered Bidding Documents holders, reports on the Site, and other information relevant to submitting a Bid for the Project. All official notifications, Addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including Addenda, if any, obtained from sources other than the designated website.

The Issuing Office for the Bidding Documents is:

Ketchum City Hall
191 5th Street West, Ketchum, ID 83340

Prospective Bidders may examine the Bidding Documents at the Issuing Office on Monday through Friday between the hours of 8:30 AM to 4:30 PM local time and may obtain electronic copies of the Bidding Documents from the Issuing Office as described below. Partial sets of Bidding Documents will not be available from the Issuing Office.

Pre-bid Conference

A pre-bid conference for the Project will be held on February 1, 2024 at 1:00 PM (MST) at Ketchum-SVWSD WRF, 110 River Ranch Rd Ketchum, ID, 83340. Attendance at the pre-bid conference is encouraged but not required.

Instructions to Bidders.

For all further requirements regarding bid submittal, qualifications, procedures, interpretations / addenda, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

This Advertisement is issued by:

Owner: City of Ketchum and SVWSD

By: Trent Donat

tdonat@ketchumidaho.org

Title: Ketchum City Clerk

Date: February 1, 2024

INSTRUCTIONS TO BIDDERS
FOR CONSTRUCTION CONTRACT

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ARTICLE 1—DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. Issuing Office—The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered. For this project, the Issuing Office is the office of the City Clerk of the City of Ketchum as listed in the Advertisement for Bids.

ARTICLE 2—BIDDING DOCUMENTS

- 2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use, nor does it grant or confer ownership or any property interest in the Bidding Documents and other documents distributed for the Project. Authorization to download documents, or other distribution, includes the right for Bidding Documents holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the Bidding Documents holder pays all costs associated with printing or reproduction. Paper or other types of printed documents may not be re-sold under any circumstances.
- 2.03 Owner has established a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a Bidding Documents holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered Bidding Documents holders will receive Addenda issued by Owner or Issuing Office.
- 2.04 Bidder may register as a Bidding Documents holder and obtain complete sets of Bidding Documents, in the format stated in the Advertisement or invitation to bid, from the Issuing Office. Bidders may rely that sets of Bidding Documents obtained from the Issuing Office are complete, unless an omission is blatant. Registered Bidding Documents holders will receive Addenda issued by Owner or Issuing Office.
- 2.05 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents, or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as Bidding Documents holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding

Documents or other documents obtained from plan rooms or other such sources (such as other prospective bidders), or for a Bidder's failure to obtain Addenda from a plan room.

2.06 *Electronic Documents*

- A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to prospective Bidders as Electronic Documents in the manner specified.
 - 1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader Version 2022 or later. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor any bidder's or the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.
- B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

- 3.01 Bidder must submit the following information with its bid to demonstrate Bidder's qualifications to perform the Work:
 - A. Bidder's state (or other issuing entity) contractor license number, if applicable.
 - B. Subcontractor (plumbing, HVAC, and electrical) names and license numbers.
 - C. Other required information regarding qualifications.
- 3.02 Bidder is to submit the following information with its Bid to demonstrate Bidder's qualifications to perform the Work:
 - A. Bidder's state (or other) contractor license number, if applicable.
 - B. Subcontractor and Supplier qualification information.
 - C. Other required information regarding qualifications.
- 3.03 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.04 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.05 Bidders shall be experienced in the kind of Work to be performed, shall have the or be able to obtain construction equipment necessary for the Work, and shall possess sufficient capital to properly perform the Work within the time allowed. Bids received from Bidders who have

previously failed to complete work within the time required, or who have previously performed similar work in an unsatisfactory manner, may be rejected. A Bid may be rejected if Bidder cannot show and document to Owner's satisfaction that Bidder has the necessary ability, facilities, equipment, and resources to commence the Work at the time prescribed and thereafter to prosecute and complete the Work at the rate or within the times specified. A Bid may be rejected if Bidder is already obligated for the performance of other work which would delay the commencement, prosecution or completion of the Work.

ARTICLE 4—PRE-BID CONFERENCE

- 4.01 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.
- 4.02 Information presented at the pre-bid conference does not alter the Bidding Documents. Owner or Issuing Office will issue Addenda to make any changes to the Bidding Documents that result from discussions at the pre-bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

5.01 Site and Other Areas

- A. The Site is identified in the Bidding Documents, including in Specifications Section 01 11 00 – Summary of Work. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 Existing Site Conditions

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 - b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.
 - c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any prospective Bidder on request. These reports and drawings are not part of the Contract

Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 *Other Site-Related Documents*

A. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A of these Instructions to Bidders, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:

1. 1984 Modifications – Ketchum / Sun Valley Sewage Treatment Plant (Record Drawings), dated January 1984.
2. Ketchum / Sun Valley Wastewater Treatment Facility – Aeration Basin Design Package (Record Drawings), dated May 16, 2007.

Owner will make copies of these other Site-related documents available to any Bidder on request. Such Site-related drawings, reports, and other documents (if any) may be examined at the Issuing Office] during normal business hours, Mondays through Fridays, upon 24 hours' notice to Trent Donat 208-726-3841, and tdonat@ketchumidaho.org.

B. Owner has not verified the contents of these other Site-related documents, and Bidder may not rely on the accuracy of any data or information in such documents. Bidder is responsible for any interpretation or conclusion Bidder draws from the other Site-related documents.

C. The other Site-related documents are not part of the Contract Documents.

D. Bidders are encouraged to review the other Site-related documents, but Bidders will not be held accountable for any data or information in such documents. The requirement to review and take responsibility for documentary Site information is limited to information in (1) the Contract Documents and (2) the Technical Data.

E. No other Site-related documents are available.

5.04 *Site Visit and Testing by Bidders*

A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.

B. A Site visit is scheduled following the pre-bid conference. Maps, directions, or GPS coordinates to the Site, when the Site is remote from the pre-bid conference location, will be available at the pre-bid conference.

- C. A Site visit is scheduled for February 1, 2024 at 1:00 PM MST at the Ketchum / SVWSD WRF, located at 110 River Ranch Road, Ketchum, Idaho, 83340. The location of the Site is indicated in the Bidding Documents, including in Specifications Section 01 11 00 – Summary of Work.
- D. Bidders visiting the Site are required to: (1) arrange their own transportation to the Site; and (2) each Bidder visiting the Site is responsible for providing and using its own personal protective equipment appropriate for the Site and conditions, and in accordance with posted requirements, if any. At minimum, each visitor to the Site should have an appropriate hardhat, steel-toed boots, eye and hearing protection (other than ordinary eyewear), and a high-visibility reflective safety vest. Comply with Paragraph 5.05 of these Instructions to Bidders.
- E. All access to the Site, other than during a regularly scheduled Site visit, must be coordinated through the following Owner or Engineer contact for visiting the Site: Mick Mummert, Wastewater Division Supervisor, 208-726-7825, mmummert@ketchumidaho.org. Bidder must conduct the required Site visit during normal working hours, Mondays through Fridays.
- F. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- G. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites. Contact Mick Mummert, Wastewater Division Supervisor, 208.726.7825, mmummert@ketchumidaho.org
- H. Bidder must comply with Laws and Regulations regarding excavation and location of utilities, obtain necessary permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- I. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be indicated in the Supplementary Conditions. Where the Bidding Documents indicate an Owner's safety program, visitors to the Site during the bidding phase and at other times shall comply with Owner's safety programs.

5.06 *Other Work at the Site*

- A. Reference is made to Specifications Section 01 11 00 – Summary of Work, for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other potentially confidential matters), if any.

ARTICLE 6—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

- A. The Bid Form that each Bidder will complete and submit contains express representations regarding the Bidder’s examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications, and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.
- B. If Bidder is awarded the Contract, Successful Bidder (as Contractor) will make similar express representations and certifications when it signs the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

- 7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- 7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Owner in writing and carbon-copy Engineer. Contact information and submittal procedures for such questions are as follows:
 - A. Trent Donat, Ketchum City Clerk.
 - 1. Phone: 208.726.3841
 - 2. Email: tdonat@ketchumidaho.org
 - B. Brad Bjerke, Engineer.
 - 1. Phone: 208-387-7073.
 - 2. Email: brad.bjerke@hdrinc.com
- 7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all Bidding Documents holders registered with the Issuing Office. Questions received less than seven days prior to the date for opening of Bids may not be answered.
- 7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Bidding Documents.
- 7.05 Addenda that engineer judges to have a material or significant effect on Bidders’ preparation of pricing and other requirement element of the Bid will be transmitted via Addendum for Bidders’ receipt not less than three days prior to the scheduled date for receipt of the Bids. Clarifications or modifications that Engineer deems will not have a material or substantial effect on the

preparation of Bids may be transmitted for Bidders' receipt later, for receipt prior to the deadline for receipt of Bids.

ARTICLE 8—BID SECURITY

8.01 *Required Form and Amount of Bid Security*

- A. A Bid must be accompanied by bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions.
- B. Such bid bond will be issued in the form included in the Bidding Documents.

8.02 *Bid Security of Successful Bidder*

- A. The Bid security of the apparent Successful Bidder will be retained until Owner awards the Contract to such Bidder, and such Bidder has signed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Successful Bidder's bid security will be released.
- B. If the Successful Bidder fails to sign and deliver the Contract and furnish the required Contract security within the number of days, indicated in Paragraph 20.01 of these Instructions to Bidders, after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the bid security of that Bidder will be forfeited.
- C. Upon Successful Bidder's default:
 - 1. When the bid security is a penal sum bid bond, the entire penal sum amount of the bid bond will be forfeit and due Owner.
 - 2. When the bid security is a damages form of bid bond, to the extent of Owner's damages will be forfeit and due Owner.
 - 3. If a type of bid security other than a bid bond is allowed and is furnished, the amount that will be forfeit and due Owner will be the same as for the form of bid bond included in the Bidding Documents. Owner will so notify the defaulting Bidder in writing of the annulment and the amount of the forfeiture, with documentation of the amount forfeited.
- D. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 *Bid Security of Bidders other than the Successful Bidder*

- A. The bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon bid security furnished by such Bidders will be released.
- B. Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the bid opening.
- C. Release of Bid Security: Owner may release any Bidder's bid security by returning such bid security to the associated Bidder. When bid security is in the form of a bid bond, Owner may dispose of or destroy the bid bond and so advise the associated Bidder in writing that the bid bond has been released.

ARTICLE 9—CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any), are to be achieved are set forth in the Agreement.
- 9.02 Provisions for liquidated and special damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND “OR EQUAL” ITEMS

- 10.01 The Contract for the Work, as awarded, will be on the basis of materials, equipment, and procedures specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items or procedures. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment or procedure, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 10.02 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, and will perform the Work in accordance with procedures indicated in the Bidding Documents, as supplemented by Addenda, if any. Assumptions regarding the possibility of post-bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so in the Specifications or elsewhere in the Bidding Documents. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should not submit a Bid.
- 11.02 The Bidder must submit to Owner in the Bid Form a list of the Subcontractors and Suppliers proposed for the following portions of the Work:
- A. Electrical.
 - B. Plumbing.
 - C. HVAC.
- 11.03 The list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier (or evidenced by Class of license appropriate for the dollar value of the Work). If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such

substitution, and Owner may consider such price adjustment in evaluating Bids and awarding the Contract.

- 11.04 If apparent Successful Bidder declines to make a requested substitution, Owner may award the Contract to another Bidder, consistent with the basis for evaluating the Bids for award as set forth in these Instructions to Bidders, that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to issuance of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
 - B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words “No Bid” or “Not Applicable.”
- 12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8.5inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.
- 12.03 A Bid by a corporation must be signed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.
- 12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.
- 12.05 A Bid by a limited liability company must be signed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.
- 12.06 A Bid by an individual must show the Bidder’s name and official address.
- 12.07 A Bid by a joint venture must be signed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.08 All names must be printed in ink below the signatures.

- 12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be indicated on the Bid Form.
- 12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.
- 12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 *Lump Sum*

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

ARTICLE 14—SUBMITTAL OF BID

- 14.01 The Bidding Documents includes the Bid Form and Bid Proposal and other required supplements to the Bid Form. The copy of the Bid Form and supplements (if any) is to be completed and submitted with the Bid security and the other documents required with the Bid by Article 2 of the Bid Form.
- 14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, and the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery method, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement or invitation to bid. The Bidder shall be aware that "over-night" delivery is often not reliable due to the Owner's mountain location and/or winter travel conditions.
- 14.03 Bids received after the date and time prescribed for the opening of Bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened. Owner accepts no responsibility for delays in returning Bids submitted or delivered to the incorrect location.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

- 15.01 An unopened Bid may be withdrawn by an appropriate document duly signed in the same manner that a Bid must be signed and delivered to the place where Bids are to be submitted, prior to the

date and time established in the Bidding Documents for the receipt of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

- 15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 of this Article and submit a new Bid prior to the date and time for established in the Bidding Documents the receipt of Bids.
- 15.03 If, within 24 hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the bid security will be returned.

ARTICLE 16—OPENING OF BIDS

- 16.01 Bids will be opened at the time and place indicated in the Advertisement or invitation to bid and, unless obviously non-responsive, will be read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.
- 16.02 An abstract of the amounts of the base Bids will be furnished by Owner or Engineer upon request.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.
- 18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. Owner may reject the Bid of any Bidder that fails to demonstrate appropriate qualifications, experience, and resources for the Work, in accordance with Article 3 of these Instructions to Bidders.
- 18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.
- 18.04 *Basis for Award of Contract*
- A. If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest-priced, responsive Bid that has not otherwise been disqualified.
 - B. Owner reserves the right to award the Contract to the Bidder determined by Owner to be in Owner's best interest, regardless of whether such Bid is the lowest-priced Bid received.

18.05 *Evaluation of Bids*

A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or elsewhere in the Bidding Documents, or prior to the Notice of Award.

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

18.07 Owner, with or without Engineer's assistance, may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

19.01 Paragraph 2.01 and Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, set forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the signed Agreement to Owner (or Owner's representative), it must be accompanied by required bonds and insurance documentation.

19.02 Article 8 ("Bid Security") of these Instructions to Bidders addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unsigned counterparts of the Agreement, along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and required bonds and insurance documentation (as required by the Contract Documents) to Owner. Within 10 days thereafter, Owner will deliver one fully signed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

21.01 The Buyer is tax exempt per Idaho State Tax Commission *Form ST-101 Sales Tax Resale or Exemption Certificate* item 5 (Pollution Control) for improvements to real property used to meet water quality standards. The signed copy of said certificate shall be provided with the Agreement. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information.

ARTICLE 22—CONTRACTS TO BE ASSIGNED (NOT USED)

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BID FORM

FOR CONSTRUCTION CONTRACT

CITY OF KETCHUM AND SUN VALLEY WATER & SEWER DISTRICT

AERATION UPGRADES

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

ARTICLE 1—OWNER AND BIDDER

- 1.01 This Bid is submitted to: City of Ketchum/Sun Valley Water & Sewer District; 191 5th Street West (PO Box 2315), Ketchum, ID, 83340. Attention Trent Donat.
- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

- 2.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors and associated license numbers (table in this Bid Form);
 - C. Evidence of authority to do business in the state of the Project; and
 - D. Contractor's license number as evidence of Bidder's State Contractor's License with the Class commensurate with the value of the Work.

ARTICLE 3—BASIS OF BID—LUMP SUM BID

- 3.01 *Lump Sum Bids*
- A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum price:
- 1. Lump Sum Price (Single Lump Sum)

Lump Sum Bid Price (in numbers)	\$
---------------------------------	----

(written amount)

ARTICLE 4—TIME OF COMPLETION

- 4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of days indicated in the Agreement.
- 4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER’S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, SUBCONTRACTOR’S LIST, AND RECEIPT OF ADDENDA

5.01 *Bid Acceptance Period*

- A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

5.02 *Instructions to Bidders*

- A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 *Subcontractors List*

- A. As required by Idaho Statute (67-2310), Contractor shall list “self” and appropriate specialty license number or Subcontractor name, address, and license number.

Discipline	Name and Address	License No.
Plumbing		
HVAC		
Electrical		

5.04 *Receipt of Addenda*

- A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder’s Representations*

- A. In submitting this Bid, Bidder represents the following:
1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
 6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder’s (Contractor’s) safety precautions and programs.
 7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
 8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
 9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
 10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
 11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 - c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
 - d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

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

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

Bidder's Address for giving notices:

Bidder's Contact Person:

Name:

(typed or printed)

Title:

(typed or printed)

Phone:

Email:

Address:

Bidder's Contractor License No.: (if applicable)

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BID BOND (PENAL SUM FORM)

<p>Bidder</p> <p>Name: _____</p> <p>Address (<i>principal place of business</i>): _____</p>	<p>Surety</p> <p>Name: _____</p> <p>Address (<i>principal place of business</i>): _____</p>
<p>Owner</p> <p>Name: City of Ketchum and Sun Valley Water and Sewer District</p> <p>Address (<i>principal place of business</i>): Ketchum City Hall P.O. Box 2315 191 5th Street West Ketchum, ID 83340</p>	<p>Bid</p> <p>Project (<i>name and location</i>): Ketchum / SVWSD WRF – Aeration Upgrades 110 River Ranch Road Ketchum, Idaho 83340</p> <p>Bid Due Date: February 14, 2024</p>
<p>Bond</p> <p>Penal Sum: _____</p> <p>Date of Bond: _____</p>	
<p>Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.</p>	
<p>Bidder</p> <p style="text-align: center;">_____ <i>(Full formal name of Bidder)</i></p>	<p>Surety</p> <p style="text-align: center;">_____ <i>(Full formal name of Surety) (corporate seal)</i></p>
<p>By: _____ <i>(Signature)</i></p>	<p>By: _____ <i>(Signature) (Attach Power of Attorney)</i></p>
<p>Name: _____ <i>(Printed or typed)</i></p>	<p>Name: _____ <i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p>Attest: _____ <i>(Signature)</i></p>	<p>Attest: _____ <i>(Signature)</i></p>
<p>Name: _____ <i>(Printed or typed)</i></p>	<p>Name: _____ <i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p><i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i></p>	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs 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 will be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner, or
 - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must 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 Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will 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 will 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 governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

BID BOND (DAMAGES FORM)

<p>Bidder Name: _____ Address (<i>principal place of business</i>): _____</p>	<p>Surety Name: _____ Address (<i>principal place of business</i>): _____</p>
<p>Owner Name: City of Ketchum and Sun Valley Water and Sewer District Address (<i>principal place of business</i>): Ketchum City Hall P.O. Box 2315 191 5th Street West Ketchum, ID 83340</p>	<p>Bid Project (<i>name and location</i>): Ketchum / SVWSD WRF – Aeration Upgrades 110 River Ranch Road Ketchum, Idaho 83340 Bid Due Date: _____</p>
<p>Bond Bond Amount: _____ Date of Bond: _____</p>	
<p>Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.</p>	
<p>Bidder</p>	<p>Surety</p>
<p style="text-align: center;">_____ <i>(Full formal name of Bidder)</i></p>	<p style="text-align: center;">_____ <i>(Full formal name of Surety) (corporate seal)</i></p>
<p>By: _____ <i>(Signature)</i></p>	<p>By: _____ <i>(Signature) (Attach Power of Attorney)</i></p>
<p>Name: _____ <i>(Printed or typed)</i></p>	<p>Name: _____ <i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p>Attest: _____ <i>(Signature)</i></p>	<p>Attest: _____ <i>(Signature)</i></p>
<p>Name: _____ <i>(Printed or typed)</i></p>	<p>Name: _____ <i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p><i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i></p>	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder any difference between the total amount of Bidder's Bid and the total amount of the Bid of the next lowest, responsible Bidder that submitted a responsive Bid, as determined by Owner, for the work required by the Contract Documents, provided that:
 - 1.1. If there is no such next Bidder, and Owner does not abandon the Project, then Bidder and Surety shall pay to Owner the bond amount set forth on the face of this Bond, and
 - 1.2. In no event will Bidder's and Surety's obligation hereunder exceed the bond amount set forth on the face of this Bond.
 - 1.3. Recovery under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs 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 will be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner, or
 - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions will not in the aggregate exceed 120 days from Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond must be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must 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 Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will 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 will 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 governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

QUALIFICATIONS STATEMENT

ARTICLE 1—GENERAL INFORMATION

1.01 The Qualifications Statement shall be completed by the apparent low-bidder.

A. Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business’s organizational structure:

Form of Business:	<input type="checkbox"/> Sole Proprietorship <input type="checkbox"/> Partnership <input type="checkbox"/> Corporation		
<input type="checkbox"/> Limited Liability Company <input type="checkbox"/> Joint Venture comprised of the following companies:			
1.			
2.			
3.			
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Pending	

1.03 Identify all businesses that own Business in whole or in part (25% or greater), or that are wholly or partly (25% or greater) owned by Business:

Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	

Address:			
Name of business:		Affiliation:	
Address:			

1.04 Provide information regarding the Business’s officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts:	<input type="checkbox"/> Yes <input type="checkbox"/> No	Limit of Authority:	\$
Name:		Title:	
Authorized to sign contracts:	<input type="checkbox"/> Yes <input type="checkbox"/> No	Limit of Authority:	\$
Name:		Title:	
Authorized to sign contracts:	<input type="checkbox"/> Yes <input type="checkbox"/> No	Limit of Authority:	\$
Name:		Title:	

ARTICLE 2—LICENSING

2.01 Provide information regarding licensure for Business:

Name of License:			
Licensing Agency:			
License No:		Expiration Date:	
Name of License:			
Licensing Agency:			
License No:		Expiration Date:	

ARTICLE 3—SAFETY

3.01 Provide information regarding Business’s safety organization and safety performance.

Name of Business’s Safety Officer:			
Safety Certifications			
Certification Name	Issuing Agency	Expiration	

3.02 Provide Worker’s Compensation Insurance Experience Modification Rate (EMR), Total Recordable Frequency Rate (TRFR) for incidents, and Total Number of Recorded Manhours (MH) for the last 3 years and the EMR, TRFR, and MH history for the last 3 years of any proposed Subcontractor(s)

that will provide Work valued at 10% or more of the Contract Price. Provide documentation of the EMR history for Business and Subcontractor(s).

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

ARTICLE 4—SURETY INFORMATION

4.01 Provide information regarding the surety company that will issue required bonds on behalf of the Business, including but not limited to performance and payment bonds.

Surety Name:			
Surety is a corporation organized and existing under the laws of the state of:			
Is surety authorized to provide surety bonds in the Project location?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Is surety listed in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” published in Department Circular 570 (as amended) by the Bureau of the Fiscal Service, U.S. Department of the Treasury?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):			Phone (claims):

ARTICLE 5—INSURANCE

5.01 Provide information regarding Business’s insurance company(s), including but not limited to its Commercial General Liability carrier. Provide information for each provider.

Name of insurance provider, and type of policy (CLE, auto, etc.):		
Insurance Provider	Type of Policy (Coverage Provided)	
Are providers licensed or authorized to issue policies in the Project location?	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Does provider have an A.M. Best Rating of A-VII or better?		<input type="checkbox"/> Yes <input type="checkbox"/> No	
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 6—CONSTRUCTION EXPERIENCE

6.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

6.02 Provide information regarding the Business’s previous contracting experience.

Years of experience with projects like the proposed project:			
As a general contractor:		As a joint venturer:	
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:			
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Been barred from contracting by any local, state, or federal agency within the last 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Been released from a bid in the past 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Defaulted on a project or failed to complete any contract awarded to it? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Refused to construct or refused to provide materials defined in the contract documents or in a change order? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Been a party to any currently pending litigation or arbitration? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Provide full details in a separate attachment if the response to any of these questions is Yes.			

6.03 List all projects currently under contract in Schedule A and provide indicated information.

6.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business’s experience with projects similar in type and cost of construction.

6.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the

Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 7—REQUIRED ATTACHMENTS

- 7.01 Provide the following information with the Statement of Qualifications:
- A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.
 - B. Certification of Business's safety performance if required by Paragraph 3.02.
 - C. Attachments providing additional information as required by Paragraph 6.02.
 - D. Schedule A (Current Projects) as required by Paragraph 6.03.
 - E. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 6.04.
 - F. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 6.05.
 - G. Additional items as pertinent.

This Statement of Qualifications is offered by:

Business: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(date signed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address: _____

Phone: _____

Email: _____

Schedule A—Current Projects

Name of Organization					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
		Name	Title/Position	Organization	Telephone
Owner					
Designer					
Construction Manager					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
		Name	Title/Position	Organization	Telephone
Owner					
Designer					
Construction Manager					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
		Name	Title/Position	Organization	Telephone
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
Name		Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
Name		Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
Name		Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
Name		Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
Name		Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					
Project Owner		Project Name			
General Description of Project					
Project Cost		Date Project Completed			
Key Project Personnel		Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
Name		Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

Safety Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Quality Control Manager			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

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SECTION 00 51 16
NOTICE OF AWARD

Date of Issuance: _____, 2024

Owners: City of Ketchum, Idaho and Sun Valley Water and Sewer District

Owner's Contract No.:

Engineer: HDR Engineering, Inc.

Engineer's Project No.: 10360008

Project: Ketchum / SVWSD WRF – Aeration Upgrades

Contract Name: Ketchum / SVWSD WRF – Aeration Upgrades

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated _____, 2024 for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

Expansion of an existing building to create a dedicated electrical room. Installation of new electrical equipment, Owner-Furnished twisted tri-lobe (aka "hybrid") blowers, submersible mixed liquor recycle (MLR) pumps, and floating mixers. Demolition of existing electrical equipment, two of three existing blowers, and sump pumps. Modifications to existing blower suction header, aeration basin diffuser grids, and replacement of existing diffuser elements and blank diffusers with membrane elements.

The Contract Price of the awarded Contract is: \$[_____].

Four (4) unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award (transmitted to Bidder electronically).

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

1. Deliver to Owner four (4) counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security (*e.g., performance and payment bonds*) and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any): None

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

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

Owners: City of Ketchum, Idaho and Sun Valley Water and Sewer District

By: Neil Bradshaw

By: James Loyd

(Authorized Signature)

(Authorized Signature)

Title: City of Ketchum, Idaho Mayor

SVWSD Board of Directors Chairman

Copy: Trent Donat, Ketchum City Clerk
Brad Bjerke, HDR Engineering

AGREEMENT

BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between Ketchum and Sun Valley Water & Sewer District (SVWSD) (“Owner”) and [_____] (“Contractor”).

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

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

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

Construction of a new electrical room on an existing building. Providing new electrical gear to existing motors in the new electrical room. Installation of Owner-Furnished VFDs, installation of Owner-Furnished twisted tri-lobe (aka “hybrid”) blowers, providing submersible mixed liquor recycle (MLR) pumps, and floating mixers. Demolition of existing electrical equipment, removal of two of three existing blowers, and removal of aeration basin dewatering pumps. Modifications to existing blower suction and discharge headers, modification of aeration basin diffuser grids (replacement of existing ceramic diffuser elements with membrane type and installing new diffuser units in place of blanks).

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:

Ketchum / SVWSD WRF – Aeration Upgrades

ARTICLE 3—ENGINEER

3.01 The Owner has retained HDR Engineering, Inc. (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by Engineer.

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

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

4.02 *Contract Times: Days*

A. The Work will be substantially complete within 365 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and

completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 400 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 as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
1. *Substantial Completion:* Contractor shall pay Owner \$1,500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
 2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.
- C. *Bonus:* Contractor and Owner further recognize the Owner will realize financial and other benefits if the Work is completed prior to the time specified for Substantial Completion. Accordingly, Owner and Contractor agree that as a bonus for early completion, Owner shall pay Contractor \$500 for each day prior to the time specified above for Substantial Completion (as duly adjusted pursuant to the Contract) that the Work is substantially complete. The maximum value of the bonus will be limited to \$25,000.

- 4.05 Owner reserves the right to withhold from payments due Contractor under the Contract amounts for liquidated damages (if any), special damages (if any), and performance damages (if any) in accordance with the Contract.

ARTICLE 5—CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:
- A. For all Work other than Unit Price Work, a lump sum of \$[_____].
 - B. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the 25th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. Ninety-five (95) percent of the value of the Work completed (with the balance being retainage).
 - 1) If 50 percent or more of the Work has been completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. Ninety-five (95) percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to ninety-seven and one half (97.5) percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

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

6.04 *Consent of Surety*

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

6.05 *Interest*

- A. All amounts not paid when due will bear interest at the rate of twelve (12) percent per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

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

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor’s Representations*

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

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

8.02 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:
1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

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

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

This Agreement will be effective on _____, 2024 (which is the Effective Date of the Contract).

Owners:

City of Ketchum, Idaho
(typed or printed name of organization)

Sun Valley Water and Sewer District
(typed or printed name of organization)

By: _____
(individual's signature)

By: _____
(individual's signature)

Date: _____
(date signed)

Date: _____
(date signed)

Name: Neil Bradshaw
(typed or printed)

Name: James Loyd
(typed or printed)

Title: City of Ketchum, Idaho Mayor
(typed or printed)

Title: SVWSD Board of Directors Chairman
(typed or printed)

Attest: _____
(individual's signature)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

Address for giving notices:

Designated Representative:

Designated Representative:

Name: _____
(typed or printed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Address:

Phone: 208-721-2162

Phone: 208-622-7610

Email: nbradshaw@ketchumidaho.org
(If City of Ketchum is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

Email: _____
(If Sun Valley Water and Sewer District is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

Contractor:

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

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

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

License No.:

(where applicable)

State:

PERFORMANCE BOND

<p>Contractor</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>	<p>Surety</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>
<p>Owner</p> <p>Name: City of Ketchum and Sun Valley Water and Sewer District</p> <p>Mailing address <i>(principal place of business)</i>: Ketchum City Hall P.O. Box 2315 191 5th Street West Ketchum, ID 83340</p>	<p>Contract</p> <p>Description <i>(name and location)</i>: Ketchum / SVWSD WRF – Aeration Upgrades 110 River Ranch Road Ketchum, Idaho 83340</p> <p>Contract Price: _____</p> <p>Effective Date of Contract: _____</p>
<p>Bond</p> <p>Bond Amount: _____</p> <p>Date of Bond: _____ <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.</p>	
Contractor as Principal	Surety
_____ <i>(Full formal name of Contractor)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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

- 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.
13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

- 14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
 - 14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. Modifications to this Bond are as follows: [_____].

PAYMENT BOND

<p>Contractor</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>	<p>Surety</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>
<p>Owner</p> <p>Name: City of Ketchum and Sun Valley Water and Sewer District</p> <p>Mailing address <i>(principal place of business)</i>: Ketchum City Hall P.O. Box 2315 191 5th Street West Ketchum, ID 83340</p>	<p>Contract</p> <p>Description <i>(name and location)</i>: Ketchum / SVWSD WRF – Aeration Upgrades 110 River Ranch Road Ketchum, Idaho 83340</p> <p>Contract Price: _____</p> <p>Effective Date of Contract: _____</p>
<p>Bond</p> <p>Bond Amount: _____</p> <p>Date of Bond: _____ <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.</p>	
Contractor as Principal	Surety
_____ <i>(Full formal name of Contractor)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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

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

- 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic’s lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of “labor, materials, or equipment” that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: [_____].

STANDARD GENERAL CONDITIONS

OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS

OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

- requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.
- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.
11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

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

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents;
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

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

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

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

2.05 *Acceptance of Schedules*

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

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

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

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

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

B. *Resolving Discrepancies*

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

3.04 *Requirements of the Contract Documents*

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

- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

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

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

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

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. Abnormal weather conditions;
 - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

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

5.01 *Availability of Lands*

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

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

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

5.03 *Subsurface and Physical Conditions*

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

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

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

- C. *Reliance by Contractor on Technical Data:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

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

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

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
- a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

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

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

- of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

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

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

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

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

6.04 *Builder's Risk and Other Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
 2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

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

7.02 *Supervision and Superintendence*

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

7.03 *Labor; Working Hours*

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

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design;
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

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

7.09 *Permits*

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

7.10 *Taxes*

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

7.11 *Laws and Regulations*

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

7.12 *Record Documents*

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

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

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

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

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

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

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

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

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
1. Observations by Engineer;
 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. Use or occupancy of the Work or any part thereof by Owner;
 5. Any review and approval of a Shop Drawing or Sample submittal;
 6. The issuance of a notice of acceptability by Engineer;
 7. The end of the correction period established in Paragraph 15.08;
 8. Any inspection, test, or approval by others; or

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

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

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

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

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

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

8.03 *Legal Relationships*

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
 - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

- 9.05 *Lands and Easements; Reports, Tests, and Drawings*
- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
 - B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
 - C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.
- 9.06 *Insurance*
- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.
- 9.07 *Change Orders*
- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.
- 9.08 *Inspections, Tests, and Approvals*
- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.
- 9.09 *Limitations on Owner's Responsibilities*
- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- 9.10 *Undisclosed Hazardous Environmental Condition*
- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.
- 9.11 *Evidence of Financial Arrangements*
- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).
- 9.12 *Safety Programs*
- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
 - B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

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

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

10.05 *Determinations for Unit Price Work*

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

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

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

10.07 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

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

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

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

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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

11.04 *Field Orders*

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

11.05 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
 3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

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

B. *Change Proposal Procedures*

1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
2. *Supporting Data:* The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

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

ARTICLE 12—CLAIMS

12.01 *Claims*

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 - 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 - 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
 5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

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

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
- 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
- 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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

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

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

D. *Contractor's Fee*

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

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

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

13.02 Allowances

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

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

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

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

14.01 *Access to Work*

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

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

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

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

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

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

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

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

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

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

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

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

- b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. The Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. The Contract Price has been reduced by Change Orders;
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 Substantial Completion

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

- d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

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

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

- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

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

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

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

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

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

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SUPPLEMENTARY CONDITIONS

OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS

OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

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

The paragraph address system used in these Supplementary Conditions is the same as the paragraph address system used in the General Conditions, with the prefix "SC" added—for example, "Paragraph SC-4.05."

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

SC-1.01.A.16 Add the following to Paragraph 1.01.A.16:

When the Project is to be constructed under multiple direct Contracts awarded by the Owner, the term "Contractor" shall mean the appropriate prime contractor. Whenever a specific prime Contractor is referred to, terms such as "General Contractor", "Electrical Contractor", "Plumbing Contractor", "HVAC Contractor", or other appropriate Contract-indicating term will be used.

SC-1.01.A.40 Add the following to Paragraph 1.01.A.40:

Trucking, shipping, delivery firms, consultants, and entities performing testing or inspection retained by Contractor or any Subcontractor are considered to be Subcontractors.

SC-1.01.A.45 Add the following to Paragraph 1.01.A.45:

Entities that rent construction equipment or machinery, but are not incorporated into the Work, are considered to be Suppliers. If such rental entity furnishes both equipment and one or more personnel to operate and maintain the equipment, such entity is a Subcontractor.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

SC-2.01 Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:

- B. *Evidence of Contractor's Insurance:* When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

2.02 *Copies of Documents*

SC-2.02 Amend the first sentence of Paragraph 2.02.A to read as follows:
Owner shall furnish to Contractor one paper copies of the Contract Documents (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF).

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

- A. Owner shall furnish to Contractor one paper copy of conformed Contract Documents incorporating and integrating all Addenda and amendments, if any, negotiated prior to the Effective Date of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional paper copies of the conformed Contract Documents for Contractor use will be the responsibility of the Contractor.

2.06 *Electronic Transmittals*

SC-2.06 Delete in its entirety Paragraph 2.06.B and replace with the following new paragraph:

- B. *Electronic Document Protocol*: Comply with Specifications Section 01 31 26 – Electronic Communication Protocols.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

SC-3.01 Delete Paragraph 3.01.C in its entirety.

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

- F. The Specifications and other verbal components of the Contract Documents may vary in form, format, and style. Some Specification sections are written in varying degrees of streamlined or declarative style and some Specifications sections may, in comparison, employ a more-narrative style. Omissions of such words and phrases as "Contractor shall," "in conformity with," "as shown," or "as specified" are intentional in streamlined language in the Contract Documents. Omitted words and phrases are incorporated by inference. Similar types of provisions may appear in various parts of a Specifications section or elsewhere in the Contract Documents. Contractor shall not attempt to take advantage of any variation of form, format or style in Change Proposal(s) and Claim(s).
- G. Cross referencing of Specification sections in a Specifications section's heading "Related Sections includes, but are not necessarily limited to: "and elsewhere within each Specifications section is provided as an aid and convenience to Contractor. Contractor shall not rely on cross referencing indicated and is responsible for coordinating the entire Work and providing a complete Project whether or not cross referencing is provided in each Specifications section or whether or not cross referencing is complete.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.05 *Delays in Contractor's Progress*

SC-4.05.C Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

- a. If “abnormal weather conditions” as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: (1) that weather conditions were abnormal for the period of time in which the delay occurred, (2) that such weather conditions could not have been reasonably anticipated, and (3) that such weather conditions had an adverse effect on the Work on the critical path at the time of the delay.
- b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:
 - 1) Every workday on which one or more of the following conditions exist will be considered a “bad weather day”:
 - i) Total precipitation (as rain equivalent) occurring between 7:00 p.m. on the preceding day (regardless of whether such preceding day is a workday) through 7:00 p.m. on the workday in question equals or exceeds 1.0 inch of precipitation (as rain equivalent, based on the snow/rain conversion indicated in Table SC-4.05.C-1—Foreseeable Bad Weather Days.
 - ii) Ambient outdoor air temperature at 11:00 a.m. is equal to or less than the following low temperature threshold: 10 degrees Fahrenheit; or, at 3:00 p.m. the ambient outdoor temperature is equal to or greater than the following high temperature threshold: 95 degrees Fahrenheit.
 - 2) Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by Western Regional Climate Center weather monitoring station at Ketchum Ranger Station (104845).
 - 3) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in Table SC-4.05.C-1—Foreseeable Bad Weather Days.
 - 4) In each month, every bad weather day exceeding the number of foreseeable bad weather days established in Table SC-4.05.C-1—Foreseeable Bad Weather Days, will be considered as “abnormal weather conditions.” The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor’s then-current Progress Schedule’s critical path for the Project.

Table SC-4.05.C-1—Foreseeable Bad Weather Days

Month	Number of Foreseeable Bad Weather Days in Month Based on Precipitation as Rain Equivalent (inches) ⁽¹⁾	Ambient Outdoor Air Temperature (degrees F)	
		Number of Foreseeable Bad Weather Days in Month Based on Low Temperature (at 11:00 a.m.)	Number of Foreseeable Bad Weather Days in Month Based on High Temperature (at 3:00 p.m.)
January	0	15	0
February	0	11	0
March	0	3	0
April	0	0	0
May	1	0	0
June	0	0	1
July	0	0	6
August	0	0	3
September	0	0	1
October	1	1	0
November	0	3	0
December	1	13	0

Notes:

- Two inches of sleet equal one inch of rain. Five inches of wet, heavy snow equal one inch of rain. Fifteen inches of “dry” powder snow equals one inch of rain.
- The Project Area commonly retains snow on the ground from late October to early May each year.

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

5.03 Subsurface and Physical Conditions

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

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Ketchum Sewage Treatment Plant Addition	2/7/1990	Subsurface foundation soil conditions (Blower Building)

- F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to

the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
1984 Modifications – Ketchum / Sun Valley Sewage Treatment Plant	January 1984	Design of existing Blower Building and appurtenances.
Ketchum / Sun Valley Wastewater Treatment Facility – Aeration Basin Design Package	4/16/2007	Design of existing Aeration Basin 03 and Aeration Basin 04 and appurtenances.
Ketchum/Sun Valley WWTF – Diffuser Plan	9/14/2005	Design and installation of diffuser grids and appurtenances for existing Aeration Basin 03 and Aeration Basin 04.

- G. Contractor may examine copies of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents at the Ketchum / SVWSD WRF during regular business hours, or may request copies from Engineer. Request access to hard copies of record drawings from Wastewater Superintendent.

SC-5.04.A Add the following new paragraph immediately after Paragraph 5.04.A.4:

5. Contractor encounters human remains, recognizes the existence of burial markers, archaeological sites, historical sites, artifacts of potential archaeological or historical interest, or wetlands not shown or indicated in the Contract Documents, Contractor shall immediately cease operations that may disturb such area(s) and secure the adjacent Work; and Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations (Contractor shall continue to suspend such operations until otherwise instructed by Owner but shall continue with all other operations that do not affect those remains or features);

5.06 *Hazardous Environmental Conditions*

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

- A. There are no reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner. B. Not used.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition).
2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition).

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.B:

1. The correction period specified as one year after the date of Substantial Completion in Paragraph 15.08.A of the General Conditions is hereby revised to be eighteen months after Substantial Completion.
2. After Substantial Completion, Contractor shall furnish a warranty bond issued in the form of EJCDC® C-612, Warranty Bond (2018). The warranty bond must be in a bond amount of 10 percent of the final Contract Price. The warranty bond period will extend to a date eighteen months after Substantial Completion of the Work. Contractor shall deliver the fully executed warranty bond to Owner prior to or with the final Application for Payment, and in any event not later than six (6) months after Substantial Completion.
3. The warranty bond must be issued by the same surety that issues the performance bond required under Paragraph 6.01.A of the General Conditions.

6.02 *Insurance—General Provisions*

1. Contractor may obtain worker’s compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker’s compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker’s compensation insurance for similar projects by the state within the last 12 months.

6.03 *Contractor’s Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

- D. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: Contractor shall list by legal name (not Project role or classification) other persons or entities to be included as additional insureds. See GC-6.03.C.
- E. *Workers’ Compensation and Employer’s Liability:* Contractor shall purchase and maintain workers’ compensation and employer’s liability insurance, including, as applicable, United States Longshoreman and Harbor Workers’ Compensation Act, Jones Act, stop-gap employer’s liability coverage for monopolistic states, and foreign voluntary workers’ compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers’ Compensation and Related Policies	Policy limits of not less than:
Workers’ Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman’s)	Statutory
Foreign voluntary workers’ compensation (employer’s responsibility coverage), if applicable	Statutory

Workers' Compensation and Related Policies	Policy limits of not less than:
Employer's Liability	
Bodily injury by accident - each accident	\$500,000
Bodily injury by disease - each employee	\$500,000
Bodily injury by disease - aggregate	\$500,000

- F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:
1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
 2. damages insured by reasonably available personal injury liability coverage, and
 3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage.
 - a. Such insurance must be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
 4. Underground, explosion, and collapse coverage.
 5. Personal injury coverage.
 6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
 7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of “insured contract” (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured’s vicarious liability, strict liability, or statutory liability (other than worker’s compensation).
6. Any limitation or exclusion based on the nature of Contractor’s work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	\$1,000,000
Products—Completed Operations Aggregate	\$1,000,000
Personal and Advertising Injury	\$1,000,000
Bodily Injury and Property Damage—Each Occurrence	\$1,000,000

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

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	\$1,500,000
Each Accident	\$1,500,000
Property Damage	
Each Accident	\$1,500,000

- K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer’s liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	\$1,000,000
General Aggregate	\$1,000,000

- L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer’s liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy’s policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of \$2,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.
- M. *Contractor’s Pollution Liability Insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor’s operations and completed operations. This insurance must be maintained for no less than three years after final completion.

Contractor’s Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	N/A
General Aggregate	N/A

- N. *Contractor’s Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor’s Professional Liability	Policy limits of not less than:
Each Claim	\$1,000,000
Annual Aggregate	\$1,000,000

- O. *Railroad Protective Liability Insurance:* Not applicable. P. *Unmanned Aerial Vehicle Liability Insurance:* If Contractor uses unmanned aerial vehicles (UAV—commonly referred to as drones) at the Site or in support of any aspect of the Work, Contractor shall obtain UAV liability insurance in the amounts stated; name Owner, Engineer, and all individuals and entities identified in the Supplementary Conditions as additional insureds; and provide a certificate to Owner confirming Contractor’s compliance with this requirement. Such

insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy.

Unmanned Aerial Vehicle Liability Insurance	Policy limits of not less than:
Each Claim	\$1,000,000
General Aggregate	\$1,000,000

6.04 *Builder’s Risk and Other Property Insurance*

SC-6.04 Delete Paragraph 6.04.A and insert the following in its place:

- A. Owner shall purchase and maintain builder’s risk insurance upon the Work on a completed value basis, in the amount of the Work’s full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder’s risk insurance are set forth in the Supplementary Conditions.

SC-6.04 Supplement Paragraph 6.04 with the following provisions:

- F. *Builder’s Risk Requirements:* The builder’s risk insurance must:
 1. be written on a builder’s risk “all risk” policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).
 - a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.
 - b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder’s risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.
 2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for

the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).
4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of \$500,000.
5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of \$500,000.
6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.
7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.
8. include performance/hot testing and start-up, if applicable.
9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.
10. include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:
 - a. Contractor shall list by legal name (not Project role or classification) other persons or entities to be insured on the builder's risk policy. It is generally recommended to list the insured's full legal/contractual name, address, contact person, telephone, and e-mail address. Include only persons or entities that have property at the Site that is to be insured by the builder's risk insurance. If applicable, separately identify any mortgagee or lender required to be named as a loss payee.
11. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:
 - a. Aeration Blower 02 & 03 (B-302 & B-303): \$206,000.
 - b. Variable frequency drives (VFDs) for new and existing equipment: \$144,125.
 1. Aeration Blower 02 (B-302) VFD, 150 HP. New blower.
 2. Aeration Blower 03 (B-303) VFD, 150 HP. New blower.
 3. RAS Pump 01 (P-301) VFD, 25 HP. Existing pump.
 4. RAS Pump 02 (P-302) VFD, 25 HP. Existing pump.
 5. RAS Pump 03 (P-303) VFD, 25 HP. Existing pump.
 6. WAS Pump (P-304) VFD, 3 HP. Existing pump.

7. MLR Pump 05 (P-311) VFD, 12 HP. New pump.
8. MLR Pump 06 (P-312) VFD, 12 HP. New pump.
9. MLR Pump 07 (P-313) VFD, 12 HP. New pump.
10. MLR Pump 08 (P-314) VFD, 12 HP. New pump.

12. If debris removal in connection with repair or replacement of insured property is subject to a coverage sublimit, such sublimit will be a minimum of \$500,000.

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provision:

- G. *Coverage for Completion Delays:* The builder's risk policy will include, for the benefit of Owner, loss of revenue and soft cost coverage for losses arising from delays in completion that result from covered physical losses or damage. Such coverage will include, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, compensation for loss of net revenues, rental costs, and attorneys' fees and engineering or other consultants' fees, if not otherwise covered.

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

- H. *Builder's Risk and Other Property Insurance Deductibles:* The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.
1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount of not more than \$500,000 for direct physical loss in any one occurrence.

SC-6.04 Delete Paragraph 6.04.A and substitute the following in its place:

A. *Installation Floater*

1. Contractor shall provide and maintain installation floater insurance on a broad form or "all risk" policy providing coverage for materials, supplies, machinery, fixtures, and equipment that will be incorporated into the Work ("Covered Property"). Coverage under the Contractor's installation floater will include loss from covered "all risk" causes (perils) to Covered Property:
 - a. of the Contractor, and Covered Property of others that is in Contractor's care, custody, and control;
 - b. while in transit to the Site, including while at temporary storage sites;
 - c. while at the Site awaiting and during installation, erection, and testing;
 - d. continuing at least until the installation or erection of the Covered Property is completed, and the Work into which it is incorporated is accepted by Owner.
2. The installation floater coverage cannot be contingent on an external cause or risk, or limited to property for which the Contractor is legally liable.
3. The installation floater coverage will be in an amount sufficient to protect Contractor's interest in the Covered Property. The Contractor will be solely responsible for any deductible carried under this coverage.

4. This policy will include a waiver of subrogation applicable to Owner, Contractor, Engineer, all Subcontractors, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them.

ARTICLE 7—CONTRACTOR’S RESPONSIBILITIES

7.02 Supervision and Superintendence

SC-7.02 Add the following to Paragraph 7.02, following Paragraph 7.02.B:

- C. Unless Owner otherwise agrees in writing, 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.

7.03 Labor; Working Hours

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7:30 AM to 7:00 PM, local time.
2. Owner's legal holidays are:
 - a. New Year’s Day (January 1st);
 - b. Martin Luther King Jr./Idaho Human Rights Day (3rd Monday in January);
 - c. President’s Day (3rd Monday in February);
 - d. Memorial Day (last Monday in May);
 - e. Juneteenth National Independence Day (June 19th);
 - f. Independence Day (July 4th);
 - g. Labor Day (1st Monday in September);
 - h. Columbus Day (2nd Monday in October);
 - i. Veterans Day (November 11th);
 - j. Thanksgiving (4th Thursday in November, including following Friday);
 - k. Christmas eve and Christmas Day(December 24th and 25th).

SC-7.03 Amend the first and second sentences of Paragraph 7.03.C to state “...all Work at the Site must be performed during regular working hours, Monday through Saturday. Contractor will not perform Work on a Sunday, or any legal holiday.” The balance of Paragraph 7.03.C remains unchanged except for the foregoing.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

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

parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-7.03 Add the following new subparagraph immediately after Paragraph SC-7.03.D:

1. For purposes of administering the foregoing requirement, additional overtime costs are defined as additional hours worked outside of regular business hours in a good-faith effort to complete the Work prior to the designated milestone completion times (finish Work before end of Contract Times).

7.10 *Taxes*

SC-7.10 Add a new paragraph immediately after Paragraph 7.10.A:

- A. Owner may be partially exempt from payment of sales and compensating use taxes of the State of Idaho and of cities and counties thereof on real property to be incorporated into the Work.
 1. Owner will furnish the certificates of tax exemption (Form ST-103C or ST-101) to Contractor for use equipment to be incorporated into the Owner's real property to meet water quality standards.
 2. Owner's exemption does not apply to construction tools or machinery, construction equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.
 3. It is the Contractor's responsibility to determine the tax exemption applicability to the Work involved.

7.11 *Laws and Regulations*

SC-7.11 Add the following new paragraph immediately after Paragraph 7.10.C:

- D. Refer to Article SC-19 for Laws and Regulations that, by terms of said Laws and Regulations, are to be included in the Contract Documents. The failure to include in Article SC-19 or any Law or Regulation applicable to the performance of the Work does not diminish Contractor's responsibility to comply with all Laws and Regulations applicable to the performance of the Work.

7.13 *Safety and Protection*

SC-7.13 Insert the following after the second sentence of Paragraph 7.13.G:

The following Owner safety programs are applicable to the Work: Ketchum / SVWSD WRF Safety/Training Manual.

7.14 *Hazard Communication Programs*

SC-7.14 Add the following new paragraph immediately after Paragraph 7.14.A:

- B. *Single Prime Contract:* Contractor shall be responsible for coordinating exchange of 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 and Regulations. Contractor shall provide a centralized location for the maintenance of the safety data sheets or other hazard communication information required to be made available by any employer on the Site. Location of the material safety data sheets or other hazard

communication information shall be readily accessible to the employees of employers on the Site.

ARTICLE 8—OTHER WORK AT THE SITE

8.02 *Coordination*

SC-8.02 Add the following new Paragraph 8.02.C immediately after Paragraph 8.02.B:

- C. Owner intends to contract with others for the performance of other work at or adjacent to the Site, which is indicated in Specifications Section 01 11 00 – Summary of Work.
 - 1. N/A.

ARTICLE 9—OWNER’S RESPONSIBILITIES

9.13 *Owner’s Site Representative*

SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

9.13 *Owner’s Site Representative*

- A. Owner will furnish an “Owner’s Site Representative” (OSR) to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner’s Site Representative will be defined at the preconstruction meeting.

ARTICLE 10—ENGINEER’S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

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

- C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
 - 1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor’s safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 - 2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR’s own personal safety while at the Site.
 - 3. *Liaison*
 - a. Serve as Engineer’s liaison with Contractor. Working principally through Contractor’s authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

- b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
- c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.

4. *Review of Work; Defective Work*

- a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
- b. Observe whether any Work in place appears to be defective. This does not impose on either RPR or Engineer any obligation to find all, or any specific element of, defective Work, for which Contractor remains solely responsible.
- b. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*

- a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to (1) code-required tests and special inspections, and (2) those performed by public or other agencies having jurisdiction over the Work.
- b. Observe specific tests, inspections, and other field quality control required by the Contract Documents and performed by Contractor, Subcontractor, Supplier, or by testing or laboratories retained by any of them, .
- c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

6. *Payment Requests:* Review Applications for Payment with Contractor and advise Contractor regarding quantities or extent of the Work eligible for payment.

7. *Completion*

- a. Participate in Engineer's visits regarding inspection for Substantial Completion.
- b. Assist in the augmenting or amending the punch list of items to be completed or corrected prior to final inspection.
- c. *Final Inspection:* Participate in Engineer's visit to the Site, in the company of Owner and Contractor, regarding completion of the Work, and prepare a final punch list (if any) of items to be completed or corrected by Contractor.
- d. Observe whether items on the final punch list have been completed or corrected.
- d. *Record Documents:* Periodically during the Work, review with Contractor the status of Contractor's record documents required by the Contract Documents and advise Contractor on whether such record documents appear to comply with the Contract's requirements for record documents. Review final record documents submitted by Contractor.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials, equipment (including “or-equal” items), or procedures or sequences indicated in the Contract Documents.
2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control or responsibility over any aspect of the means, methods, techniques, sequences or procedures of construction.
5. Advise on, issue directions regarding, or assume control over security protection, or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11—CHANGES TO THE CONTRACT

No Supplementary Conditions in this Article.

ARTICLE 12—CLAIMS

No Supplementary Conditions in this Article.

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 Cost of the Work

SC-13.01.B.5.c.(1) Supplement Paragraph 13.01.B.5.c.(1) by adding the following subparagraphs:

- a) Prior to commencing Work at the Site, submit to Owner, through Engineer, copies of the equipment rental blue book intended for use in rates typical for equipment rented within 200 miles of project.
- b) Should Contractor perform Work using rented construction equipment or machinery without Owner’s written approval of the associated rental agreement and the parties subsequently disagree on the applicable rental rates, use of such construction equipment and machinery will be compensated on the basis of the rental rate book indicated in Paragraph SC-13.01.B.5.c.(2).
- c) When the rental rate book is used basis for determining compensation for construction equipment and machinery leased from a rental firm, the hourly rate for such equipment shall be determined in accordance with Paragraph 13.01.B.5.(2) of the General Conditions.

SC-13.01.B.5.c.(2) Supplement Paragraph 13.01.B.5.c.(2) by adding the following sentence:

The equipment rental rate book that governs the included costs for the rental of machinery and equipment owned by Contractor (or a related entity) under the Cost of the Work

provisions of this Contract is the most current edition of The Blue Book – Building & Construction Network (Tates Rents – Boise Idaho, or equal)..

SC-13.01.B.5.c Supplement Paragraph 13.01.B.5.c by adding the following subparagraphs:

- 4) *Inactive Equipment and Machinery*: Rental of construction equipment and machinery shall cease when the use thereof is no longer necessary for the Work. Periods of inactivity for such construction equipment or machinery will not be compensable unless agreed upon in writing by Owner, unless the costs of disassembly, removal, transportation, reassembly, and remobilization, as submitted to and accepted by Owner (with advice of Engineer) would exceed the cost of continuing to rent the item(s) during the period(s) of inactivity. Contractor is responsible for obtaining Owner’s written approval for compensation for construction equipment and machinery for periods of inactivity. Owner is not responsible for retroactively approving such inactivity. “Period of inactivity” for such items includes periods when the construction equipment or machinery is not used or necessary for the logical and efficient progression of the Work, or when other, available equipment or machinery is suitable for performing the given task.
- 5) *Condition of Equipment and Machinery*: Construction equipment and machinery will be compensable only for serviceable construction equipment and machinery capable of efficiently performing its intended function at the Site. Construction equipment and machinery not in compliance with this Paragraph SC-13.01.B.5.c.5) is not eligible for compensation.
- 6) *Capped Compensation*: Compensation paid Contractor for a given item of Contractor-owned construction equipment or machinery will be capped at, and shall not exceed, the comparable purchase price of such item of equal or comparable capacity and capability.

SC-13.01.C.2 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

a. For purposes of this paragraph, “small tools and hand tools” means items in one or more of the following categories: (1) Items that are ordinarily required for the performing worker’s job function, including but not limited to equipment which ordinarily has no associated licensing, insurance, or substantive storage costs; such as hammers, wrenches, socket tools, manual saws, power saws, chainsaws, common power tools, impact drills, threaders, benders, transits and theodolites and related equipment, and other tools transportable by hand, regardless of ownership of such items; (2) Items such as gang-boxes, ladders, hand carts and similar wheeled items manually operated by workers, extension cords, and similar items; (3) common testing equipment such as insulation testers (megger-testing equipment), amp meters, gas detectors, pressure gauges, and similar items; (4) A purchase price (if purchased new, at retail) of \$500, although such limit is not absolute, and certain items may be deemed by Owner or Engineer as “small tools or hand tools” (and not eligible for compensation) even though such item may have a purchase price greater than the amount indicated in this Paragraph 13.01.C.2.

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

- a. the extended price of a particular item of Unit Price Work amounts to 5 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 20 percent from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
 3. Adjusted unit prices will apply to all units of that item.

E. Adjustments in Unit Price

1. Contractor or Owner shall be entitled to an adjustment in the unit price if the quantity on an individual bid item extends or fails to achieve 80 percent of the estimated quantity at the time of Contract formation plus any additions or deletions included in change orders to the contract.
2. The adjusted unit price will apply only to all units installed for that bid item.

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

No Supplementary Conditions in this Article.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.01 Progress Payments

SC-15.01.C.1 Change 10 days to 14 days.

SC-15.01.D.1 Change 10 days to 30 days.

SC-15.01 Add the following new Paragraph 15.01.F:

- F. For contracts in which the Contract Price is based on the Cost of Work plus a fee, if Owner determines that progress payments made to date substantially exceed the actual progress of the Work (as measured by reference to the Schedule of Values), or present a potential conflict with the Guaranteed Maximum Price, then Owner may require that Contractor prepare and submit a plan for the remaining anticipated Applications for Payment that will bring payments and progress into closer alignment and take into account the Guaranteed Maximum Price (if any), through reductions in billings, increases in retainage, or other equitable measures. Owner will review the plan, discuss any necessary modifications, and implement the plan as modified for all remaining Applications for Payment.

15.03 Substantial Completion

SC-15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined by Engineer not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer or other entity retained by Owner, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

15.08 *Correction Period*

SC-15.08.G Add the following new Paragraph 15.08.G:

- G. The correction period specified as one year after the date of Substantial Completion in Paragraph 15.08.A of the General Conditions is hereby revised to be the number of years set forth in Paragraph SC-6.01.B.1; or if no such revision has been made in SC-6.01.B, then the correction period is hereby specified to be one and one-half (1.5) year after the date of Substantial Completion established in Engineer's certificate of Substantial Completion.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

17.02 *Arbitration*

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

SC-17.02 *Arbitration*

- A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of \$100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be concurrently sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or, if no specified time is applicable, within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.
- C. The arbitration will be held in the same municipality as the Site.
- D. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrator(s) will have no authority to award punitive or other damages not measured by the prevailing party's actual

damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.

- E. The Arbitrator(s) will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.
- F. The award of the arbitrator(s) must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.
- G. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.
- H. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:
 - 1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;
 - 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;
 - 3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and
 - 4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.
- I. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.
- J. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

17.03 *Attorneys' Fees*

SC-17.03 Add the following new paragraph immediately after Paragraph 17.02.

SC-17.03 *Attorneys' Fees*

- A. For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18—MISCELLANEOUS

18.08 *Assignment of Contract*

SC-18.11 Add a new paragraph immediately after Paragraph 18.10:

SC-18.11 *Confidential Information*

- A. All Drawings, Specifications, technical data, and other information furnished to Contractor either by Owner or Engineer or developed by Contractor or others in connection with the Work are, and will remain, the property of Owner or Engineer, and shall not be copied or otherwise reproduced or used in any way except in connection with the Work, or disclosed to third parties or used in any manner detrimental to the interests of Owner or Engineer.
- B. The following information is not subject to the above confidentiality requirements:
 - 1. information in the public domain through no action of Contractor in breach of the Contract Documents; or
 - 2. information lawfully possessed by Contractor before receipt from Owner or Engineer; or
 - 3. information required to be disclosed by Laws or Regulations, or by a court or agency of competent jurisdiction. However, in the event Contractor shall be so required to disclose such information, Contractor shall, prior to disclosure, provide reasonable notice to Owner and Engineer, who shall have the right to interpose all objections Owner may have to the disclosure of such information.

SC-18.12 Add a new paragraph immediately after Paragraph 18.11, to read as follows:

SC-18.12 *Publicity*

- A. Contractor shall not disclose to any third party the nature of its Work on the Project, nor engage in publicity or public media disclosures with respect to the Project without the prior written consent of Owner.

SC-19 Add new article immediately after Article 18, to read as follows:

ARTICLE SC-19 – STATUTORY REQUIREMENTS

SC-19.01 This article contains portions of certain Laws or Regulations which, by provision of Laws or Regulations, are required to be included in the Contract Documents. The matters addressed in this Article SC-19 may not be complete or current. Contractor's obligation to comply with all Laws and Regulations is set forth in Paragraph 7.11 of the General Conditions.



Ketchum / SVWSD WRF – Aeration Upgrades

City of Ketchum and Sun Valley Water and Sewer District
Ketchum, Idaho

ADDENDUM NO. [1]
[Month] [Day], [Year]

TO: Prospective Bidders

FROM: HDR (Engineer)
412 East Parkcenter Boulevard, Suite 100
Boise, Idaho 83716

OWNERS: City of Ketchum Sun Valley Water and Sewer District
P.O. Box 2315 49 Larrys Lane
191 5th Street West Sun Valley, Idaho 83353
Ketchum, Idaho 83340

SUBJECT: Ketchum / SVWSD WRF – Aeration Upgrades

This Addendum is part of the Bidding Documents and the Contract Documents and modifies the original Bidding Documents dated [____], as indicated below. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to disqualification for award of the associated Contract.

This Addendum consists of [____] pages and the attachments, if any, listed on the last page.



ADDENDUM NO. [1] SEALS AND SIGNATURES

<p><i>Brad Bjerke, PE</i> License No. 8778</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 01.• Division 02.• Division 07.• Division 08.• Division 09.• Division 10.• Division 23.• Division 31.• Division 32.• Division 40.• Division 41.• Division 43.• Division 46.
<p><i>Ron Manske, PE</i> License No. 21207</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 03.• Division 04.• Division 05.• Division 06.
<p><i>John Barrutia, PE</i> License No. 7051</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 26.



Engineer's seal and signature does not apply to the documents, or changes thereto, that comprise Division 00, Bidding and Contracting Requirements, except for revisions to provisions of prior Addenda that modify the Specifications and Drawings.

It is a violation applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the proposed Specifications, Drawings, and Addenda for this Project.

CHANGES TO PRIOR ADDENDA

None

CHANGES TO INTRODUCTORY INFORMATION

None

CHANGES TO BIDDING REQUIREMENTS

None

CHANGES TO CONTRACTING REQUIREMENTS

None

CHANGES TO SPECIFICATIONS

None

CHANGES TO DRAWINGS

None

ATTACHMENTS

None

END OF ADDENDUM NO. [1]

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DIVISION 01

GENERAL REQUIREMENTS



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SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Location and description of Work and prior uses of the Site.
 2. Construction Contracts for this Project.
 3. Others retained by Owner for the Project.
 4. Work by others under Owner's control on other projects.
 5. Work by others not under Owner's control.
 6. Work by Owner.
 7. Sequence and progress of Work.
 8. Contractor's use of the Site.
 9. Easements and rights-of-way.
 10. Partial utilization by Owner.
 11. Utility owners.
- B. Related Requirements:
1. Include, but are not limited to, the following:
 - a. Section 01 14 16 - Coordination with Owner's Operations.
 - b. Section 01 14 19 - Use of Site
 - c. Section 01 64 00 - Owner-Furnished Products.

1.2 LOCATION AND DESCRIPTION OF WORK

- A. The Work is located at the Ketchum / SVWSD WRF, located in the southern portion of Ketchum, ID (110 River Ranch Rd, Ketchum, ID 83340).
- B. Work to be performed under this Contract includes, but is not limited to; expansion of an existing building to create a dedicated electrical room, installation of new electrical equipment, Owner-Furnished VFDs, Owner-Furnished blowers, submersible mixed liquor recycle (MLR) pumps, and floating mixers. Miscellaneous demolition including, but not limited to; existing electrical equipment, two of three existing blowers, and miscellaneous piping. Modifications to existing blower suction header, aeration basin diffuser grids, and replacement of existing diffuser elements and blank diffusers with membrane elements. And all other Work required in accordance with the Contract Documents.
- C. The Project includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below. The Work includes, but is not limited to, the following:
1. Expansion of existing Aeration Blower Building.
 2. Demolition of existing aeration basin dewatering pumps.
 3. Installation of new:
 - a. Electrical infrastructure (including Owner-Furnished VFDs).
 - b. Owner-Furnished hybrid blowers.
 - c. Floating mixers.
 - d. Submersible pumps.
 - e. New piping and conduit.
 - f. Associated appurtenances.
- D. Contracting Method: The Project will be constructed under a single prime construction Contract.

- E. Hazardous Environmental Conditions:
 - 1. The existing blower building was constructed in 1984 but does not show any hazardous construction materials.
 - 2. The aeration basin floor is approximately 16 feet below top of wall and will require safe entrance and exit for the Work. Contractor shall determine requirements for working in the confined space.
- F. Owner-Furnished Materials and Equipment:
 - 1. Administrative and procedural requirements for Owner-furnished materials and equipment to be incorporated into the Work are in Section 01 64 00 - Owner-Furnished Products.

1.3 CONSTRUCTION CONTRACTS FOR THIS PROJECT

- A. Single Prime Construction Contract: The Contract requires all the Work for the Project not expressly allocated to Owner or others in the Contract Documents.

1.4 OTHERS RETAINED BY OWNER FOR THE PROJECT

- A. Engineer:
 - 1. Engineer is identified in the Agreement.
 - 2. Engineer's responsibilities for the Project, relative to Contractor, are indicated throughout the Contract Documents.
 - 3. Whether the Engineer will furnish the services of a Resident Project Representative (RPR) for the Project is indicated in the Supplementary Conditions.
- B. Non-Professional Services Contracted by Owner: Owner will retain services of the following entities to perform the services indicated relative to the Project. Contractor shall coordinate and schedule the Work with, and cooperate with, the entities performing the following services for Owner.
 - 1. Code-Required Special Inspections and Testing:
 - a. Owner has, or will, retain the services of a qualified testing laboratory to perform code-required testing and special inspections for the Work, in accordance with Section 01 45 33 - Code-Required Special Inspections and Procedures, and selected other provisions of the Contract Documents related to field testing.
 - 2. SCADA Configuration and Integration Services:
 - a. Owner has, or will, retain the services of a qualified systems integration firm to perform SCADA configuration services and other information technology services relative to the Work, in accordance with Section 40 90 05 - Control Loop Descriptions.
 - b. Identification: SCADA configuration and integration services will be performed by Banyan Technology, Inc., 1250 Madrona Street North, Twin Falls, Idaho 83303.

1.5 WORK BY OWNER

- A. Owner will perform the following in connection with the Work:
 - 1. Operate all existing valves, flow-control gates, pumps, equipment, and appurtenances that will affect Owner's operations or facility processes, unless otherwise specified or indicated.

1.6 SEQUENCE AND PROGRESS OF WORK

- A. Sequencing:
 - 1. Incorporate sequencing of the Work into the Progress Schedule.
 - 2. See 01 14 16 - Coordination with Owner's Operations and Engineer for detailed sequencing requirements.
 - 3. Contractor is responsible for coordination of Work and overall project sequencing (Work Plan). The following general sequencing is provided to assist:
 - a. Work in/around existing Aeration Blower Building:
 - 1) Expansion of existing Aeration Blower Building to house new electrical infrastructure.
 - 2) Electrical infrastructure to be installed in the Aeration Blower Building electrical room expansion.

- a) Existing electrical infrastructure in blower room shall be demolished once new electrical equipment has been successfully commissioned.
 - 3) Owner-Furnished hybrid blower installation.
 - a) Existing turbo blower B-302 and B-303 can be removed from service when the temporary hybrid blower installation is complete and operational.
 - b) Modifications to the existing blower suction and discharge header droplegs will be completed to provide an isolated system. B-303 will be temporarily relocated outdoors as indicated in Drawings.
 - c) Final installation of new blowers B-302 and B-303 and their associated suction and discharge header droplegs will be completed in coordination with existing electrical infrastructure demolition. All electrical equipment to be demolished must be removed before header droplegs can be installed.
 - 4) Blower suction header modifications.
 - a) Exterior piping modifications and temporary blower installation must be completed before shutting the existing blower system down for construction of the new air intake filters and final permanent hybrid blower installation.
 - b. Work in existing Aeration Basin 03 and Aeration Basin 04:
 - 1) Aeration Basin 04 is anticipated to have approximately 1.75 feet (level to diffuser membrane) of grit accumulated in the basin floor requiring removal prior to diffuser work. Aeration Basin 03 was cleaned by Owner recently and is not expected to need cleaning for diffuser work.
 - a) Grit removal work must be performed to avoid damaging existing diffuser grids.
 - 2) Demolition of existing aeration basin dewatering sump pumps and associating piping.
 - a) Must be coordinated with Owner. Pumps must be used to dewater basins prior to demolition. Pumps shall be retained by Owner.
 - 3) Modifications to the existing Cell 3 diffuser laterals to accommodate new submersible pumps.
 - 4) Replace existing diffuser elements and blank diffusers with new membrane diffuser elements.
 - 5) Provide new submersible mixed-liquor recycle (MLR) pumps.
 - 6) Provide new piping, conduit, and associated appurtenances for equipment in the aeration basin area.
 - 7) Provide floating mixers.
 - a) Requires aeration basins to be filled before installation can begin. Filling basins with mixed liquor is acceptable. Coordinate basin filling with Owner.
 - 8) Provide new instruments in Aeration Basins 3 and 4.
- B. Requirements for sequencing and coordinating with Owner's operations, including maintenance of facility operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 16 - Coordination with Owner's Operations.

1.7 CONTRACTOR'S USE OF SITE

- A. Use of Site - General:
 - 1. Limits on Contractor's use of the Site are indicated in Section 01 14 19 - Use of Site, and as may be shown on the Drawings.
 - 2. Contractors shall share use of the Site with other contractors and others specified in Articles 1.3 through 1.6 (inclusive) of this Section.
 - 3. Relocate stored materials and equipment that interfere with operations of Owner, other contractors, and others performing work for Owner.
 - 4. Comply with restrictions set forth in Section 01 14 19 - Use of Site.
- B. Owner will occupy the Site jointly with Contractor during construction for performance of Owner's typical operations. Coordinate with Owner in all construction operations to minimize

conflicts between Contractor and Owner's employees and others under Owner's control. If the Site is a treatment facility or other production facility, Owner will have Owner's suppliers for deliveries of chemicals and other items accessing the Site from time to time, possibly on a daily basis.

1.8 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and Rights-of-Way - General:
 - 1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by Owner in accordance with the General Conditions and Supplementary Conditions.
 - 2. Confine construction operations within Owner's property, public rights-of-way, easements obtained by Owner, and limits shown, and property for which Contractor has made arrangements directly with property owner(s).
 - 3. Use care in placing construction tools, machinery and equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
 - 4. Do not enter private property outside the construction limits without permission from the owner of the property.
- B. On Private Property:
 - 1. General limits of Owner-furnished easements are shown on the Drawings.

1.9 PARTIAL UTILIZATION BY OWNER

- A. Prior to Substantial Completion of the entire Work under the Contract, substantially complete the Work as follows:
 - 1. Work indicted for Milestones (if any).
 - a. Aeration Blower Building modifications.
 - b. Aeration suction header modification
 - c. New electrical equipment and blower installation.
 - d. Demolition of existing electrical equipment.
 - e. In-basin modifications.

1.10 UTILITY OWNERS

- A. Utilities known to Engineer and that may have Underground Facilities or other facilities in the vicinity of the Work are:
 - 1. Intermountain Gas Company:
 - a. Natural gas services.
 - b. 220 South River Street, Hailey, ID 83333.
 - c. Telephone: 800-548-3679.
 - 2. Idaho Power Company:
 - a. Electrical services.
 - b. 121 Hospital Drive, Ketchum, ID 83340.
 - c. Telephone: 208-726-5520.
 - 3. CenturyLink:
 - a. Telephone services.
 - b. 250 1st Avenue, Bliss, ID 83314.
 - c. Telephone: 855-508-3495.
 - 4. Sun Valley Water and Sewer District:
 - a. Potable water services.
 - b. 49 Larrys Lane, Sun Valley, ID 83353.
 - c. Telephone: 208-622-7610.
 - 5. Syringa Networks:
 - a. Fiber optic services.
 - b. 12301 West Explorer Drive Boise, ID 83713.
 - c. Telephone: 208-229-6100.

- B. Utilities and their owners indicated in the Contract Documents are for Contractor's convenience. Neither Owner nor Engineer will be liable to Contractor or any utility owner for failure to indicate utility, its owner, or complete and correct contact information in the Contract Documents where Contractor's reasonable and ordinarily-exercised diligence would reveal the presence of the utility and its owner. Nothing in the Contract mitigates Contractor's responsibilities under the General Conditions, and Laws and Regulations, including "call before you dig" regulations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 13 13

MILESTONES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Section describes the Work to be substantially completed to comply with Milestones indicated in the Agreement.
 2. This Specifications section is not intended to describe all the Work or its constraints, interrelationships, or sequential requirements.

1.2 GENERAL

1. Contractor shall provide all labor, materials, equipment, tools, and incidentals required to perform the Work in accordance with the Contract Times provisions of the Contract Documents.
2. To achieve each Milestone indicated in this the Contract Documents, substantially complete those elements of the Work indicated starting with Article 1.2 of this Specifications Section, together with related materials, equipment, systems, and appurtenant Work and activities.
3. Comply with the General Conditions, as may be modified by the Supplementary Conditions, and other provisions of the Contract Documents, regarding partial utilization and property insurance.

1.3 WORK TO ACHIEVE MILESTONES

- A. Milestone No. 1 – Aeration Blower Building Expansion:
1. To achieve this Milestone, substantially complete the following Work:
 - a. Construct new electrical room for the Aeration Blower Building.
 - b. Modify blower suction header, including demolition as indicated in Drawings.
- B. Milestone No. 2 – Electrical Equipment Installation and Demolition:
1. To achieve this Milestone, substantially complete the following Work:
 - a. Incrementally install and commission new electrical equipment in the new electrical room of the Aeration Blower Building.
 - b. Incrementally remove existing electrical infrastructure in blower room from service and demolish equipment.
- C. Milestone No. 3 – Blower Modifications, Demolition, and Installation:
1. To achieve this Milestone, substantially complete the following Work:
 - a. Install new Owner Furnished hybrid blower (B-303) in temporary outdoor location.
 - b. After temporary blower installation, the existing building blower suction and discharge droplegs can be modified, including demolition as indicated in Drawings.
 - c. Remove existing B-302 (non-operational turbo) and replace with Owner-Furnished B-302.
 - d. Remove existing B-303 and replace with Owner-Furnished B-303 once new blower VFD is installed and operational.
- D. Milestone No. 4 – Aeration Basin 03 Modifications:
1. To achieve this Milestone, substantially complete the following Work:
 - a. Demolition of existing aeration basin dewatering sump pumps and associated piping. Must be coordinated with Owner. Existing sump pumps must be used to dewater basin.
 - b. Modify existing Cell 3 diffuser laterals to accommodate new submersible pumps.
 - c. Replace existing diffuser elements and blank diffusers with new membrane diffuser elements.
 - d. Install new submersible mixed-liquor recycle (MLR) pumps.

- e. Install new piping, conduit, and associated appurtenances for equipment.
 - f. Installation of floating mixer. Requires basins to be filled before installation can begin. Basin filling must be coordinate with Owner.
- E. Milestone No. 5 – Aeration Basin 04 Modifications:
- 1. To achieve this Milestone, substantially complete the following Work:
 - a. Remove grit from AB 04 floor in all cells.
 - b. Demolition of existing aeration basin sump pumps and associated piping. Must be coordinated with Owner. Existing sump pumps must be used to dewater basin.
 - c. Modify existing Cell 3 diffuser laterals to accommodate new submersible pumps.
 - d. Replace existing diffuser elements and blank diffusers with new membrane diffuser elements.
 - e. Install new submersible mixed-liquor recycle (MLR) pumps.
 - f. Install new piping, conduit, and associated appurtenances for equipment.
 - g. Installation of floating mixer. Requires basins to be filled before installation can begin. Basin filling must be coordinate with owner.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 14 16
COORDINATION WITH OWNER'S OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for coordinating with Owner's operations during the Project.
 2. Requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Specifications section.
- B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with Owner's operations during the Work in accordance with this Specifications section.
 2. Except for shutdowns specified in this Specifications section, perform the Work such that Owner's facilities remain in continuous, satisfactory operation during the Project. Schedule and perform the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, does not affect the public health, safety, welfare, and convenience, and does not adversely affect the environment resulting in violation of Laws or Regulations.
 3. Work not specifically addressed in this Specifications section or in referenced sections may, in general, be performed, to be completed within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this section.
- C. Related Requirements: Include but are not necessarily limited to:
1. Section 01 11 00 - Summary of Work.
 2. Section 01 13 13 - Milestones.
 3. Section 01 73 29 - Cutting and Patching.
 4. Section 01 75 00 - Checkout and Startup Procedures.
 5. Section 02 41 00 - Demolition.

1.2 REFERENCES

- A. Terminology:
1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Specifications section have the meaning indicated below:
 - a. The term "Owner" is used throughout this section. When the facility is operated or managed by an entity other than Owner, references in this section to "Owner" as the operator or manager of the facility will be interpreted as referring to the facility manager.
 - b. A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
 - c. A "tie-in" is a connection of new Work to existing facilities, including connecting to existing conduits (including piping and ducting), electrical systems, structural elements, process/mechanical elements, and other physical connections. Some tie-ins may require that the tie-in be made without an associated shutdown.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work indicated in this Section.

- B. Sequencing and Scheduling:
 - 1. Refer to this Specifications sections articles on sequencing, tie-ins, and shutdowns.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Shutdown Planning Submittal:
 - a. For each shutdown, submit an inventory of labor, materials, and equipment required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
 - b. Furnish submittal to Engineer not less than 30 days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning Submittal.
 - 2. Shutdown Notification:
 - a. After Engineer's acceptance of shutdown planning Submittal and prior to starting the shutdown, submit written notification to Owner and Engineer of date and time each shutdown is to start. Submit notification not less than 72 hours in advance of each shutdown.

1.5 GENERAL CONSTRAINTS

- A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials and equipment may be used by Owner after the specified field quality control activities are successfully completed and the materials or equipment are substantially complete in accordance with the Contract Documents.
- B. The following constraints apply to coordination with Owner's operations:
 - 1. Regular business hours at the Ketchum / SVWSD WRF are 7:00 a.m. to 3:30 p.m. local time, Monday through Friday. Standby operations staff availability is limited on weekends.
 - 2. Operational Access: Owner's personnel shall have access to equipment and areas of the facility that remain in operation.
 - 3. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational. Comply with Section 01 51 05 - Temporary Utilities.
 - 4. Schedule and perform equipment and system start-ups in accordance with Section 01 75 00 - Checkout and Startup procedures. Equipment and systems shall not be placed into operation on Friday, Saturday, Sunday, or holidays without prior approval of Owner, unless specifically indicated otherwise in the Contract Documents.
 - 5. Dead End Valves or Conduits:
 - a. Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting.
 - b. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as necessary or as required by Engineer.
 - c. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
 - 6. Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean, dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
 - 7. Draining and Cleaning of Conduits, Tanks, and Basins:
 - a. Unless otherwise shown or indicated in the Contract Documents, Contractor shall dewater process tanks, basins, conduits (including piping) at beginning of each

shutdown. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas.

- b. Contractor shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by Engineer. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, and other means provided by Contractor. Discharge of fluids across floors is not allowed.
- c. If drainage point is not available on the conduit (including piping) to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of contents of conduits (including piping) is not allowed.
- d. Spillage shall be brought to Engineer's attention immediately, both orally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps or other appropriate location and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other means, such as vactor truck, sorbents, or other method acceptable to Engineer.

1.6 SEQUENCE OF WORK

- A. Perform the Work in the indicated sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed substitute sequence, with Engineer's approval. Stages specified in this article are sequence-dependent.
- B. Stage I – Aeration Blower Building:
 1. Expansion of the blower building must be prioritized so that the new electrical infrastructure can be installed for the secondary treatment system.
 2. Temporary installation of a new Owner-Furnished hybrid blower outside the blower building and electrical work associated with the temporary blower to allow piping work interior to the blower building.
 3. Aeration Suction and Discharge Header:
 - a. Blower suction header modifications shall be installed while blower building expansion work is active.
 - b. Piping modifications shall occur after the temporary blower is operational thereby allowing the shutting the old blower system down for switch-over to the new intake filters and discharge piping.
 - c. Modifications to the Blower Building's existing air plenum room and future electrical room expansion shall be prioritized and must be completed before installation of new electrical equipment can occur.
- C. Stage II – Demolition of Existing Electrical Equipment:
 1. Existing electrical infrastructure in blower room shall be demolished once new electrical equipment has been successfully commissioned.
- D. Stage III – Installation of New Electrical Equipment and Blowers:
 1. Installation of new electrical equipment.
 - a. All new electrical infrastructure must be systematically installed and power must be cutover from existing electrical infrastructure.
 2. Installation of Owner-Furnished hybrid blowers.
 - a. Existing B-302 will be removed from service and replaced with the new B-302 (Owner Furnished). The existing B-302 is non-operational.

- b. Once new temporary blower B-303 is operational, existing blower suction and discharge droplegs will be removed as indicated and modified to provide an isolated system.
 - c. Existing blower B-303 (turbo) shall be removed and replaced with Owner-furnished new blower B-303 (hybrid) after new intake filter is in place and interior piping is complete.
- E. Stage IV – Aeration Basin (AB) 03 and 04:
- 1. In-basin work shall begin by taking AB 03 offline. AB 04 must remain in service while AB 03 is offline.
 - a. AB 04 shall not be taken offline until all work in AB 03 has been completed and successfully commissioned. AB 03 must be in service while AB 04 is offline.
 - 2. In-basin work on AB 04 work cannot begin until AB 03 is complete. AB 03 must remain in service while AB 04 is offline.
 - 3. All in-basin work must be coordinated with Owner.
 - 4. Basin must be dewatered using the existing dewatering sump pumps. The pumps and associated piping will be removed.
 - a. Sump pumps to be removed shall be returned to Owner. Coordinate storage with Owner.
 - 5. Basin cleaning must be performed for AB 04 prior to any other work. AB 03 does not require manual grit removal.
 - 6. Cell 3 diffuser laterals must be modified to accommodate new submersible pumps.
 - 7. Replace existing diffuser elements and blank diffusers with new membrane diffuser elements in Cells 1, 2, and 3 in both AB 03 and AB 04 per Drawings.
 - 8. Installation of new piping and conduit and associated appurtenances for equipment in the aeration basin area.
 - 9. Installation of floating mixers.
 - a. Requires aeration basins to be filled before installation can begin. Filling basins with mixed liquor is acceptable. Coordinate basin filling with Owner.

1.7 TIE-INS

- A. Table 01 14 16-A in this Specifications section lists connections by Contractor to existing facilities. Table 01 14 16-A may not indicate all tie-ins required for the Work; Contractor shall perform tie-ins necessary and required to complete the Work as shown or indicated in the Contract Documents, regardless of whether tie-in is indicated in Table 01 14 16-A. For tie-ins not indicated in Table 01 14 16-A, obtain requirements for tie-ins from Engineer by requesting an interpretation or clarification.

1.8 SHUTDOWNS

- A. Shutdowns shall be in accordance with Table 01 14 16-B of this Specifications section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
- B. Work that may interrupt normal operations shall be accomplished at times convenient to Owner unless otherwise indicated in the Contract Documents.
- C. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.
- D. Fines and Penalties Imposed by Authorities Having Jurisdiction:
 - 1. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
 - 2. Owner or Engineer may deduct as set-offs such amounts from payments due Contractor.

- E. Temporary, short-term shutdowns of smaller conduits (including piping and ducting), equipment, and systems may not be included in Table 01 14 16-B. Coordinate requirements for such shutdowns with Engineer and Owner. Where necessary, obtain Engineer's interpretation or clarification before proceeding.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 SUBSTITUTE PROCEDURES

- A. Proposal of Substitute Sequencing, Shutdowns, and Tie-Ins:
 - 1. As a substitute to the procedures indicated in this Specifications section, Contractor may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.
 - 2. Engineer will consider proposals for substitute procedures after the Effective Date of the Contract. All Bids shall be based on the requirements of the Contract Documents, including this section.
 - 3. Substitution Requests:
 - a. When proposing a substitute procedure for a tie-in or shutdown or other requirements of this section, comply with the requirements of the General Conditions and Supplementary Conditions (regarding substitutes) and Section 01 25 00 - Substitution Procedures.
 - b. When deviation from specified sequence or procedures is proposed, Contractor's proposal shall explain in detail the proposed sequence and procedures and associated effects, including evidence that Owner's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule.

3.2 GENERAL PROVISIONS FOR COORDINATING WITH OWNER'S OPERATIONS

- A. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on Owner's operations and processes.
- B. Operation of Existing Systems and Equipment during the Work:
 - 1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by Engineer in writing.
 - 2. Operation of existing systems and equipment will be by Owner unless otherwise specified or indicated.
 - 3. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both.
 - 4. Provide temporary watertight plugs, bulkheads, and line stops as necessary and as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.
- C. Bypassing:
 - 1. Diversion of flows around treatment processes is not allowed.
- D. Requirements for temporary pumping associated with specific shutdowns are indicated in this Specifications Section.

- E. Performing the Work of this section constitutes Contractor's approval of underlying work and field conditions prevailing at the time of the Work.

3.3 PREPARATION

- A. Coordinate preparations for removals with requirements of Section 01 73 29 - Cutting and Patching and Section 02 41 00 - Demolition, applicable.
- B. Shutdowns - General Preparation:
 - 1. Coordinate shutdowns with Owner and Engineer.
 - 2. Submit shutdown planning Submittals and shutdown notification Submittals in accordance with this Specifications section's "Submittals" Article.
 - 3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with such requirements before commencing the shutdown.
 - 4. Engineer shall have no duty to Contractor to advise Contractor of inadequate preparations by Contractor; Contractor is solely responsible for the means, methods, procedures, techniques, and sequences of construction.
- C. Shutdowns of Electrical Systems:
 - 1. Comply with Laws and Regulations, including the National Electric Code.
 - 2. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cables and wires are de-energized to ground potential before starting other Work associated with the shutdown.
 - 3. Upon completion of shutdown Work, remove the locks and tags and advise Engineer or Resident Project Representative (RPR) that facilities are available for use.

3.4 DETAILED SHUTDOWN REQUIREMENTS

- A. Timing Requirements:
 - 1. All shutdowns shall have a maximum duration of two (2) hours.
 - 2. No shutdowns shall occur consecutively. Shutdowns must have a minimum of four (4) hours between each event to re-establish operating conditions in the biological system.
- B. Shutdown A and B:
 - 1. General:
 - a. Affected Equipment Operating Prior to Shutdown: Aeration blowers (B-301, B-302, and B-303).
 - b. Equipment Operating During Shutdown: In accordance with Table 01 14 16-B of this Specifications section.
 - c. Equipment Out of Service During Shutdown: In accordance with Table 01 14 16-B of this section.
 - d. Impact on Other Equipment and Processes: Aeration Basin 01, Aeration Basin 02, Aeration Basin 03, Aeration Basin 04.
 - 1) A minimum of two aeration basins is required at any time and one of the basins in operation shall be AB 03 or AB 04.
 - 2) The temporary outdoor blower installation should make aeration equipment shutdowns unnecessary.
 - 3) Short-term equipment shut-down for equipment new electrical cut-in shall adhere to the 2-hour maximum rule.
 - 4) Any discharge permit violation fines incurred as a result of unauthorized Contractor exceeding maximum duration requirement of shutdown shall be borne by Contractor.
 - e. Procedure: New intake filters and exterior piping modifications shall be completed to the fullest extent possible prior to shutdown per Section 01 11 00 - Summary of Work

and this Section. Work to be completed during process shutdown should be completed such that only piping in the existing air plenum room will need modification.

- f. Dates: Shutdown shall be accomplished by October, 2024.
- g. Time: Shutdown shall be performed during regular business hours. Exact time of shutdown work shall be coordinated with Owner.
 - 1) Shutdown may be performed during the night for low-flow conditions. Coordinate any proposed night-time work for shutdowns with Owner.

- 2. Prior to Shutdown:
 - a. Obtain Engineer's acceptance of proposed shutdown planning Submittal and shutdown notification Submittal.
 - b. Bring necessary piping, couplings, valves, equipment, and appurtenances to the work areas.
 - c. Assist Owner in preparing to take equipment, tanks, basins, and conduits (including piping and ducting) temporarily out of service.
 - d. Coordinate other tie-ins to be performed simultaneously.
 - e. Install, check, and test the temporary blower system.
- 3. During Shutdown:
 - a. Remove existing air plenum as required to complete suction header cutting and welding.
 - b. Provide all materials for the tie-ins as shown in Drawings, and any equipment required to complete the Work.
 - c. With Owner, return equipment and system to operation.
- 4. Following Shutdown:
 - a. Verify functionality of equipment and systems.
 - b. Verify operation of new equipment and systems, and verify that joints in conduits (including piping and ducting) are watertight or gastight as applicable.
 - c. Repair joints that are not watertight or gastight, as applicable.
 - d. Remove temporary appurtenances.

C. Shutdown C:

- 1. General:
 - a. Affected Equipment Operating Prior to Shutdown: All equipment powered by MCC-M2.
 - b. Equipment Operating During Shutdown: In accordance with Table 01 14 16-B of this Specifications section.
 - c. Equipment Out of Service During Shutdown: In accordance with Table 01 14 16-B of this section.
 - d. Impact on Other Equipment and Processes: Aeration Basin 01, Aeration Basin 02, Aeration Basin 03, Aeration Basin 04, Clarifier 01, Clarifier 02.
 - 1) Shutdown for electrical cutover is a critical component of the biological treatment process. Failure to complete the shutdown in two (2) hours or less can create an upset condition to the biological system.
 - 2) Any discharge permit violation fines incurred as a result of Contractor exceeding maximum duration requirement of shutdown shall be borne by Contractor.
 - e. Procedure: New electrical infrastructure shall be installed and prepared for electrical cutover from existing MCC-M2 to the new electrical equipment prior to commencement of the cutovers.
 - f. Dates: Shutdown shall be accomplished by December, 2024.
 - g. Time: Shutdown shall be performed during regular business hours. Exact time of shutdown work shall be coordinated with Owner.
- 2. Prior to Shutdown:
 - a. Obtain Engineer's acceptance of proposed shutdown planning Submittal and shutdown notification Submittal.
 - b. Bring necessary conduit, wiring, equipment, and appurtenances to the work areas.

- c. Assist Owner in preparing to take equipment, tanks, basins, and conduits (including piping and ducting) temporarily out of service.
- d. Coordinate other tie-ins to be performed simultaneously.
- 3. During Shutdown:
 - a. Relocated wiring termination from existing MCC-M2 into new electrical infrastructure.
 - b. Provide all materials for the tie-ins as shown in Drawings, and any equipment required to complete the Work.
 - c. With Owner, return equipment and system to operation.
- 4. Following Shutdown:
 - a. Verify functionality of equipment and systems.
 - b. Verify operation of new equipment and systems, and verify that joints in conduits (including piping and ducting) are watertight or gastight as applicable.
 - c. Repair joints that are not watertight or gastight, as applicable.
 - d. Remove temporary appurtenances.

3.5 ATTACHMENTS

- A. The following, bound after this Specifications Section's "End of Section" designation, are part of this Specifications Section:
 - 1. Tables:
 - a. Table 01 14 16-A, Schedule of Tie-ins.
 - b. Table 01 14 16-B, Schedule of Shutdowns.

END OF SECTION

**Table 01 14 16-A
Schedule of Tie-Ins**

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
1	18-inch Low-Pressure Air (ALP)	24-inch ALP	Aeration Blower Building (air plenum room)	I	Must be performed overnight during low-flow conditions.
2	12-inch Low-Pressure Air (ALP)	12-inch Low-Pressure Air (ALP)	B-302 and B-303 Suction and Discharge Piping	II	
3	12-inch Low-Pressure Air (ALP)	12-inch Low-Pressure Air (ALP)	B-303 Relocation Discharge Piping – Yard Piping	II	
4	MCC-M2 (New)	MCC-M2 Cutover	Aeration Blower Building (blower room)	II	Multiple cutover events are anticipated for electrical system modifications. Each cutover event shall conform to the duration requirements set in Table 01 14 16-B.

**Table 01 14 16-B
Schedule of Shutdowns**

Shut-down No.	Process Equipment and Service Lines Out-of-Service During Shutdown	Process Equipment In Operation During Shutdown	Tie-In Nos.	Maximum Duration
A	Aeration Blowers 01, 02, and 03	Aeration Basins 01, 02, 03, and 04	1	2 hours
B-1	Aeration Blowers 01, 02, and 03	Aeration Basins 01, 02, 03, and 04	2	2 hours
B-2	Aeration Blowers 01, 02, and 03	Aeration Basins 01, 02, 03, and 04	3	2 hours
C	All equipment powered by the secondary treatment MCC (MCC-M2)	Aeration Basins 01, 02, 03, and 04; Clarifiers 01 and 02	4	2 hours

SECTION 01 14 19
USE OF SITE

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes: Restrictions on Contractor's use of the Site and premises.
 2. Restrictions on use of existing buildings and structures, including:
 - a. Permanent utilities and sanitary facilities.
 - b. Existing hoisting equipment.
- B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to comply with restrictions on Contractor's use of the Site and other areas.
 2. Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions, regarding the Contractor's use of the Site and other areas.

1.2 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Site plan showing proposed location of field offices, storage trailers, staging and laydown areas, temporary sanitary facilities, fuel and oil storage, fueling location, bottle gas storage facilities, and other areas Contractor proposes to occupy.
- B. Informational Submittals: Submit the following:
1. Notices of Condition:
 - a. Notice of condition of Owner's existing hoisting equipment that Contractor proposes to use, together with written evaluation of condition of equipment including condition of equipment's safety devices. If corrective work is necessary or advisable, transmit concurrently with the Submittal Contractor's Change Proposal for remedial work, in accordance with Section 01 26 00 - Contract Modification Procedures.
 2. Hoist Manufacturer's Reports: Submit written report of results of each visit to Site by equipment manufacturer's service technician, including purpose and time of visit, tasks performed, and results obtained.
 3. Qualifications Statements:
 - a. Identification by name, and qualifications and experience of, person Contractor proposes as Contractor's operator of Owner's hoisting equipment.

1.3 USE OF PREMISES

- A. Limit use of premises at the Site to work areas shown or indicated on the Drawings and as specified in this Section. Do not disturb portions of the Site beyond areas of the Work.
1. Limits:
 - a. Confine construction operations to the following areas:
 - 1) Aeration Basin 03, Aeration Basin 04, and Aeration Blower Building.
 - b. Confine storage of materials and equipment, and locations of temporary facilities to the following areas:
 - 1) As shown on Drawings.
 - 2) Contractor's gang boxes and storage containers for tools in active use in the Work may be kept in reasonable quantity in the work areas as long as such items do not obstruct access to the facilities by Owner or occupants.
 - 3) Do not store items of any sort, whether temporarily or otherwise, in stairways and ramps, whether existing or under construction.
 - c. Do not enter the following areas:

- 1) Areas outside of the work areas indicated in Paragraph A.1.a of the “Use of Premises” Article in this Specifications section, and outside of work areas indicated on the Drawings.
 2. Prohibitions:
 - a. Do not use the Site for the following:
 - 1) Conducting Contractor’s business not related to the Project or other work for Owner.
 - 2) Overnight lodging or other, non-work use of the Site by workers or others for whom Contractor is responsible, whether housed in recreational vehicles, other vehicles, tents, quarters in field offices or Contractor-furnished temporary structures, or in work areas, is unacceptable.
 3. Access to Site, Access Roads, Parking Areas, and Haul Routes:
 - a. Access to site through main entrance gates on River Ranch Road.
 - b. Parking areas are included in the Contractor Staging Area as shown in Drawings.
- B. Use of Existing Buildings and Structures: Maintain existing buildings and structures in weather-tight condition throughout construction unless otherwise indicated in the Contract Documents. Protect buildings, structures, and occupants during construction.
1. Use of Existing Utilities, Sanitary Facilities, and First-aid Facilities:
 - a. Refer to Section 01 51 05 - Temporary Utilities.
 - b. Do not use permanent sanitary facilities, whether provided under the Project or existing prior to the Project, at the Site.
 - c. Do not use permanent telephone, Internet, or other communications utilities and facilities at the Site, regardless of whether such services and facilities were provided under the Project or existed prior to the Project, except in cases of emergency.
 - d. Do not use Owner’s or occupants’ first-aid facilities, except in cases of medical emergency. Promptly replenish used items and supplies with items identical to those used.
 2. Use of Owner’s Hoisting Equipment and Access to Work Areas for Loading:
 - a. General Provisions:
 - 1) For each of Owner’s hoisting systems used by Contractor, Contractor shall thoroughly check the equipment and submit to Engineer written certification that Contractor believes the equipment is sufficient for the intended use and that all safety mechanisms are in place and operating. If existing equipment has one or more deficiencies, notify Engineer before attempting to use such equipment.
 - 2) When one or more deficiencies are noted in existing hoisting equipment prior to Contractor’s use thereof, Owner may authorize Contractor to perform remedial work on the hoisting equipment under a Change Order or allowance authorization (if any).
 - 3) Contractor’s person operating Owner’s hoisting equipment shall be experienced with and qualified in using such equipment. Assign one person to operate Owner’s hoisting equipment and advise Engineer in writing of the identity and experience of the designated person.
 - 4) Following completion of Contractor’s use of Owner’s hoisting equipment, remedy damage and wear caused by Contractor’s use of equipment at no cost to Owner. Perform field quality control testing and inspections as indicated in Article 3.1 of this Specifications section; if not indicated in Article 3.1, perform field quality control tests as mutually agreed upon by hoisting equipment manufacturer’s service technical and Engineer. Submit results of field quality control testing to Engineer.
 - b. Contractor may use Owner’s hoisting equipment as follows:
 - 1) Existing davit cranes for pump and mixer installation if new davit cranes cannot be commissioned in time. Contractor shall install new davit cranes as quickly as reasonably possible to use new davit cranes for pump and mixer installation.
 - a) Confirm rated load capacity of existing davit cranes prior to use.

- c. Contractor may use the hoisting equipment and access ways indicated above for moving materials and equipment during construction. Hoisting equipment shall be available to Owner and occupants at all times unless otherwise arranged with Owner and Engineer. Do not load hoisting equipment beyond posted capacity.
- C. Promptly repair damage to premises, including existing structures, finishes, equipment, and other features, caused by construction operations. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all bid/pay items.
 - 2. General provisions on unit prices and quantities.
 - 3. General provisions on lump sums.
 - 4. Listing of the various bid/pay items in the Project, together with criteria for measuring Unit Price Work for payment.
- B. Related Requirements:
 - 1. Include but are not necessarily limited to:
 - a. Section 01 26 00 - Contract Modification Procedures.
 - b. Section 01 29 73 - Schedule of Values.
 - c. Section 01 29 76 - Progress Payment Procedures.

1.2 REQUIREMENTS APPLICABLE TO ALL BID/PAY ITEMS

- A. In this Section and elsewhere in the Contract Documents, the terms “bid item”, “pay item”, “bid/pay item”, “Item” followed by a number designation, “this item”, and the like all have the same meaning, and refer to one or more specific elements of the Contract, established for pricing and payment, as indicated in the Bid Form and in the Agreement (or exhibit to the Agreement) at the time the Contract was signed by the parties.
- B. This Article applies to all bid/pay items in the Contract.
- C. Prices – General:
 - 1. The bid/pay items listed starting with Article 1.5 of this Section refer to and are the same bid items listed in the Bid Form and included in the Contract, and constitute all bid/pay items for the Work at the time the Contract was signed by the parties.
 - 2. No direct or separate payment will be made, outside of the bid/pay items in the Contract, for the following: providing miscellaneous temporary or accessory materials or equipment, temporary works, temporary construction facilities, Contractor’s project management, superintendence, and similar costs for Subcontractors or Suppliers; bonds and insurance; schedules and schedule updates; coordination (with: Owner’s operations (including, but not limited to, lockout/tag-out procedures), other contractors, utility owners, owners of transportation facilities, adjacent property owners and occupants, authorities having jurisdiction, Subcontractors and Suppliers, and others with whom Contractor is to coordinate the Work); information technology systems required by the Contract Documents; Submittals; photographic documentation; Project meetings; Contractor’s hazard communication program; Contractor’s compliance with environmental procedures for Constituents of Concern (including spill control and countermeasures plans and implementation); professional services (required for Contractor’s means and methods of construction, and for delegated designs required by the Contract Documents); obtaining and complying with permits and licenses; temporary utilities (including electric power, water supply and disposal, fuel, and communications); temporary lighting; temporary fire protection; temporary enclosures and HVAC; temporary sanitary facilities; temporary first-aid facilities and services; ; Contractor’s field offices and sheds, Engineer’s field offices (when required elsewhere in the Contract Documents); temporary vehicular access and parking (including access to the Site, temporary access roads and parking, onsite traffic controls for construction traffic, and offsite haul routes); traffic control of non-construction vehicular and pedestrian traffic; temporary controls (including temporary erosion and

sediment controls, noise control, control of storm water, surface water, and groundwater, pollution controls (including solid waste control, water pollution control, and control of atmospheric pollution), dust control, pest and rodent controls, odor controls, and other temporary controls required by the Contract Documents); temporary security for the Work; temporary barriers; Project signage (when required elsewhere in the Contract Documents); delivering, handling, and storing materials and equipment to be incorporated into the Work; layouts and surveys for the Work; construction equipment, machinery, tools, and vehicles; safety and protection; Site maintenance during construction; cleaning and removal and disposal of waste and debris; checkout and startup; testing and other quality control activities required by the Contract Documents; record documents, operation and maintenance data; warranties; spare parts and extra materials required by the Contract Documents; instruction of facility personnel as required by the Contract Documents; commissioning (when required elsewhere in the Contract Documents); Contractor's correction period, Contractor's general warranty and guarantee; Contractor's indemnification obligations; other labor, cost, or effort required by the General Conditions and Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.

3. Price Escalation:
 - a. Unless expressly indicated otherwise in the Contract Documents, Owner is not obligated to change the stipulated prices (including lump sums, unit prices, and allowances) that are all or part of the Contract Price because of escalation of costs when there is no corresponding change in the Contract Times.
 - b. Changes in the Contract Times do not necessarily entitle Contractor to a change in Contract Price due to escalation.
 - c. Should Contractor claim a change in Contract Price for one or more stipulated price pay items without a corresponding change in scope, extent, or quality in the associated Work, prior to receiving any such change in Contract Price, Contractor shall submit with Contractor's associated Change Proposal, documentation satisfactory to Engineer supporting and documenting that Contractor's costs have increased because of delays beyond Contractor's control within the associated change in Contract Times included in such Change Proposal.
 4. Compensation for all services, labor, materials, and equipment shall be included in prices stipulated for the lump sum bid/pay items in the Contract.
 5. Each lump sum in the Contract shall include an amount considered by Contractor as sufficient for all overhead and profit for each separately identified bid/pay item.
- D. Contract Price, Payment Procedures, and Related Matters:
1. Contract Price: The Contract Price, as apportioned among bid/pay items in the Contract, is indicated in the Agreement and any associated exhibits thereto and may be modified by Change Order.
 2. Payments to Contractor: Refer to the General Conditions (as may be modified by the Supplementary Conditions), the Agreement (including provisions on retainage, if any), and Section 01 29 76 - Progress Payment Procedures, among other applicable Contract Documents.
 3. Schedule of Values: Refer to the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 29 73 - Schedule of Values.
 4. Procedures for Changes in Contract Price: Refer to the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 26 00 - Contract Modification Procedures.
 5. Defective Work is not eligible for payment.

1.3 GENERAL PROVISIONS ON UNIT PRICES AND QUANTITIES

A. Quantities:

1. Quantities of Unit Price Work indicated in the Bid Form and in the Contract (at the time the Agreement was signed by the parties) are estimates for purposes of pricing and comparison of Bids.
 2. Owner does not represent, either expressly or by implication, or agree that the nature of materials encountered below ground surface or in concealed areas, or actual quantities of Unit Price Work required, will correspond with the quantities in the Contract at the time the Agreement was signed by the parties. Owner reserves the right to increase or decrease quantities, and to eliminate quantities, as Owner may deem necessary or as may be necessary due to Site conditions encountered.
 3. Adjustment of Unit Prices Due to Variation in Quantities:
 - a. Provisions, if any, regarding adjustment of unit prices due to variations in actual quantities (eligible for payment) from the estimated quantities in the Contract (including quantities at the time the Agreement was signed by the parties and as subsequently modified by Change Order) are in the General Conditions, as may be modified by the Supplementary Conditions.
 - 1) Engineer's review for possible unit price adjustment, when provision for such adjustment is expressly indicated in the Contract, will be at a time Engineer deems reasonable and proper.
 - 2) When the Supplementary Conditions establish that, to be eligible for an adjustment in the unit price, a pay item of Unit Price Work must have a total computed, extended price (at the time the Agreement was signed by the parties) equal to or greater than a specified percentage (stipulated in the Supplementary Conditions) of the total Contract Price (at the time the Agreement was signed by the parties), and the total extended price of such pay item does not exceed the stipulated percentage of the Contract Price, then the associated pay item will be paid at the unit price in the Contract without adjustment for variations in actual quantity.
 4. Quantities eligible for payment will be actual quantities furnished and installed (as applicable) in accordance with the Contract Documents, within the pay limits shown or indicated, as measured by Engineer (or other entity so empowered in the Contract Documents), and recommended for payment by Engineer.
 5. At Contractor's expense, Contractor may independently verify quantities measured by Engineer for payment. Should Contractor disagree with quantities measured and recommended for payment by Engineer, submit appropriate Change Proposal (appealing Engineer's measurements) indicating the specific reasons for Contractor's appeal, with detailed reasons therefor and associated calculations and estimates, in accordance with the Contract Documents.
 6. Quantity Overruns:
 - a. When the quantity of a pay item of Unit Price Work eligible for payment exceeds the pay item's quantity included in the Contract, Owner will pay for quantities that exceed those in the Contract only while the estimated total payments to Contractor under the Contract will not exceed the Contract Price. Otherwise, a Change Order is required to modify the associated quantity in the Contract, thus changing the Contract Price.
 7. Except as may be established elsewhere in the Contract Documents, make no claim for anticipated profit, loss of profit, damages, or additional compensation arising from difference between quantities of Unit Price Work eligible for payment and the estimated quantities in the Contract.
- B. Measuring for Payment:
1. At Engineer's option, Engineer may delegate to Resident Project Representative (RPR) (if any), some or all of Engineer's responsibilities for measuring Unit Price Work eligible for payment.
 2. Unless expressly indicated otherwise in the Contract Documents, measurements will be in United States standard measurements.
 3. Unless indicated otherwise elsewhere in the Contract Documents, quantities of Unit Price Work eligible for payment will be rounded to the nearest whole number.

4. In the event of conflict between this Section and the measurement criteria in the Specifications of Divisions 02-49, the measurement criteria in this Section will govern. Typical intent when measurement criteria are in both this Section and the associated Division 02-49 Specifications section, is for the criteria to be interpreted together.
5. Assistance with Measurements:
 - a. Assist Engineer and Resident Project Representative (RPR) (if any), by providing measuring equipment, labor, and survey personnel necessary to measure quantities eligible for payment.
6. Quantities eligible for payment can be adjusted by Engineer to correct quantities included in Contractor's prior payment requests, and for incomplete or defective Unit Price Work. Such corrections are at Engineer's sole discretion.

1.4 GENERAL PROVISIONS ON LUMP SUM ITEMS

- A. Progress payments for Work paid on a lump sum basis will be based on Engineer's estimate of the Work (in accordance with the Contract Documents) performed through the end of the associated pay period, based on the Schedule of Values accepted by Engineer in accordance with the Contract Documents.
- B. At its sole discretion, Engineer may correct amounts of lump sum Work included in prior payment requests based on improved data or information available to Engineer, or Engineer's knowledge or reasonable belief that Work is incomplete or defective.

1.5 BID/PAY ITEMS – GENERAL CONTRACT

- A. Item 1 – General Construction:
 1. Measurement: As set forth in the Contract's provisions regarding the Schedule of Values and progress payment procedures.
 2. Payment: Lump sum payment for this item will be full compensation for completing the Work, as shown and indicated in the Contract Documents not included under other bid/pay items.
- B. Item 2 – Contingency Allowance:
 1. Measurement: As indicated in the Agreement, the Contract includes in this item a stipulated amount available as reserve for sole use by Owner, for costs authorized by Owner during construction, for Work not included under other bid/pay items.
 2. Payment: Payment for Work authorized and performed under this item will be full compensation for providing all Work authorized under this allowance, complete as shown, indicated, or directed by Engineer in accordance with the associated allowance authorizations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements applicable to all substitution requests.
 - 2. Provisions specific to Contractor’s substitution requests for:
 - a. Materials and equipment to be incorporated into the Work.
 - b. Methods, procedures, and sequences indicated in the Contract Documents.
- B. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals, and pay all costs associated with requests for approval of substitutes.
 - 2. Where the Contract Documents expressly indicate that substitutes are not allowed, are unacceptable, or time-barred, do not submit substitution requests for such items or procedures.
 - 3. Requirements for Contractor’s proposal of “or-equals”, where allowed by the Contract, are in the General Conditions, as may be modified by the Supplementary Conditions.
- C. Related Requirements:
 - 1. Include, but are not necessarily limited to:
 - a. Section 00 72 13 – General Conditions (EJCDC C-700—2018).
 - b. Section 00 73 01 – Supplementary Conditions (EJCDC C-800—2018).

1.2 REFERENCES

- A. Terminology:
 - 1. The following terminology, although not indicated with initial capital letters, has the following meaning in this Section:
 - a. “Or-equal” and “or equal” each means material or equipment items to be incorporated into the completed Work as a functioning whole, or method, procedure, or sequence that, in Engineer’s sole opinion, are equivalent to that shown or indicated in the Contract Documents.
 - b. “Substitute” means a proposed materials or equipment to be incorporated into the completed Work as a functioning whole, or a proposed construction method, procedure, or sequence that is not, in Engineer’s sole opinion, equivalent to the associated, similar material or equipment item or method, procedure, or sequence shown or indicated in the Contract Documents, but accomplishes the same or similar purpose. Unless expressly indicated otherwise in the Contract Documents, Contractor’s proposals for “value engineering” (and similar terms) are substitutes.
 - c. “Substitution request” means Contractor’s written request for Engineer’s approval of a proposed substitute, in accordance with this Section. Substitution requests are separate from Shop drawings and other Submittals required by the Contract Documents.

1.3 SUBSTITUTES - GENERAL

- A. This Article applies to all substitutes and substitution requests, whether for substitute materials or equipment, or for substitute methods, procedures, or sequences.
- B. This Section expands on the provisions on substitutes in the General Conditions, as may be modified by the Supplementary Conditions.
- C. Time Limits for Submitting Substitution Requests:

1. Where the Contract allows Contractor's substitution requests, such proposals will be considered by Engineer only during a period of 60 days after the date the Contract Times start to run, unless otherwise indicated.
 2. Substitution requests will be accepted for consideration by Engineer after the time limit indicated in the paragraph above this, when materials or equipment shown or indicated, and all associated "or-equals", are either:
 - a. Unavailable; or
 - b. Despite Contractor's due diligence, are unavailable in time for the Work to be completed within the Contract Times.
 3. The foregoing notwithstanding, substitutes will not be approved when received by Engineer after Contractor has commenced the associated Work at the Site, where approval of the substitute would require rework or removing Work already installed.
- D. Design Professional:
1. Engineer is responsible for design of the completed Project as a functioning whole and has responsible charge of the Project except for Work for which design responsibility is expressly delegated by the Contract Documents.
 2. Do not retain services of any third-party design professional to prepare modifications of Engineer's design of the completed Project as a functioning whole without Engineer's express, written consent via an appropriate Contract modification setting forth appropriate performance and design criteria for delegating the design of the substitute.
- E. Contractor's Representations:
1. In submitting each substitution request, Contractor represents that:
 - a. Contractor has read and understands the Contract's provisions on substitutes, as indicated in the General Conditions, as may be modified by the Supplementary Conditions, this Section, and elsewhere in the Contract Documents.
 - b. Substitution request is complete and includes all documents and information required by the Contract Documents.
 - c. Contractor certifications required by the General Conditions, as may be modified by the Supplementary Conditions, and this Section are valid and made with Contractor's full knowledge, information, and belief.
 - d. Contractor will provide the same or better guarantees and warranties for substitute as for the specified materials, equipment, methods, procedures, and sequences (as applicable).
 - e. Contractor waives all rights for increasing the Contract Price or extending the Contract Times, related to the substitute, that subsequently may become apparent to Contractor after issuance of the associated Contract modification instrument approving such substitute, except for those associated with differing subsurface or physical conditions or discovery of a previously unforeseen Hazardous Environmental Condition associated with the Work involving the approved substitute.
- F. Submittal of Substitution Requests - General:
1. Substitution requests must be submitted by Contractor. Engineer will not accept or review substitution requests from prospective or bona-fide Subcontractors or Suppliers.
 2. Submit separate substitution request for each proposed substitute.
 3. Submit substitution requests in accordance with requirements for Shop Drawings and other Submittals, as indicated in the General Conditions, as may be modified by the Supplementary Conditions and Section 01 33 00 - Submittal Procedures.
 4. Do not submit substitution requests as any of the following (such substitution requests will be returned by Engineer without review):
 - a. Shop Drawing, Sample, or other Submittal.
 - b. Request for approval of an "or-equal".
 - c. Request for interpretation (RFI) or clarification.
 - d. Change Proposal without all other, required substitution request elements indicated below.

- e. Other oral or written communication not in accordance with this Section.
 - 5. Each substitution request shall include:
 - a. Transmittal letter (one per substitution request) expressly indicating the communication is a substitution request.
 - b. Completed substitution request form, on the form attached to this Section.
 - c. Change Proposal, submitted in accordance with the Contract Documents, including Section 01 26 00 - Contract Modification Procedures. Clearly indicate the proposed changes in Contract Price and Contract Times if substitute is approved; if none, clearly so indicate on the Change Proposal.
 - d. Certifications and written representations required by the Contract Documents to accompany substitution requests.
 - e. Other information: (1) required elsewhere in this Section and in other elements of the Contract Documents, and (2) deemed appropriate by Contractor to support Contractor's substitution request.
 - 6. When Engineer requires additional information to evaluate a substitution request, furnish such information within five days of receipt of Engineer's request, unless additional time is granted by Engineer, in writing.
 - 7. Engineer and Owner have the right to rely upon the completeness and accuracy of information, documents, certifications, and representations in Contractor's substitution request. Contractor accepts full responsibility for completeness and accuracy of substitution requests (except for Engineer's professional liability).
- G. Engineer's Review of Substitution Requests:
- 1. Engineer has no obligation to approve any substitute.
 - 2. Substitutes will not be approved unless all of the following are satisfied for the associated substitute:
 - a. The Contract supports submittal of such substitution request; and
 - b. Substitute is reasonably consistent with Engineer's design intent for the Project as a completed, functioning whole; and
 - c. As indicated in Paragraph 1.3.A.3 of this Section.
 - d. Substitute will not have an adverse effect on the work of other contractors, or existing or proposed construction; and
 - e. Substitution request is complete in accordance with the Contract Documents and Engineer's requests, and
 - f. Owner agrees to the substitute; and
 - g. Associated changes in Contract Price and Contract Times, if any, are acceptable to Owner.
 - 3. Engineer is not obligated to approve any substitute where such approval is conditioned on an increase in the Contract Price, the Contract Times, or both.
 - 4. Timeliness of Engineer's Review:
 - a. Allow not less than 14 days for Engineer's review of each substitute. Allow longer for larger, more-complex substitutes.
 - b. Engineer will endeavor to perform timely review of substitution requests. However, Contractor is responsible for complying with the Contract Times, regardless of whether the substitute is approved.
 - c. Where approval of a substitute would necessitate other changes to the Project's design, additional time, beyond that indicated above, will be necessary for Engineer's preparation of revisions to the design.
 - 5. When Design Changes are Required with Approval of Substitute:
 - a. Engineer will advise Contractor promptly following Engineer's review (and Owner's comment, if any) on substitution request to indicate whether the substitute will be acceptable. Engineer's advisory to Contractor will indicate whether changes in Engineer's design are necessary and include a preliminary estimate of Engineer's fee and time required for modifying the design and preparing an associated Proposal Request to Contractor.

- b. Engineer's preliminary estimates of fee and time for design modifications will be prepared in good faith, but are not binding on Owner or Engineer.
- c. Contractor shall reimburse Owner for costs incurred by Owner for design modifications necessitated by approval of substitute. Owner may deduct such amounts, as one or more set-offs, from payments due Contractor under the Contract.
- d. Upon Contractor's receipt of Engineer's estimate of fee and time for design modifications, contractor shall advise Engineer, in writing, within three days whether Contractor will continue pursuing approval of the substitute.
- e. Request to Contractor.
- f. Engineer may reject a substitute that would require substantial changes in the Project's design.

H. Approval of Substitutes:

- 1. Substitutes are approved only via issuance of an appropriate Field Order or Change Order in accordance with Section 01 26 00 - Contract Modification procedures, and the General Conditions, as may be modified by the Supplementary Conditions.
- 2. Approval of a substitute does not relieve Contractor from obligation to comply with the Contract Documents, including submitting Shop Drawings, Samples, and other Submittals in accordance with the Contract Documents.

1.4 SUBSTITUTE MATERIALS AND EQUIPMENT

A. In addition to other requirements of this Section and elsewhere in the Contract Documents, substitution requests for substitute materials or equipment shall include:

- 1. Manufacturer and Location:
 - a. Name and address of manufacturer of the proposed substitute. Indicate country where manufacturer is incorporated and owned.
 - b. Companies and brands owned by or affiliated with manufacturer.
 - c. Name of manufacturers of principal component items, such as motors, bearings, and similar items.
 - d. Location where the items would be manufactured, including country and address. Indicate the total percentage of the items' value that will be manufactured outside of the United States and its territories.
 - e. Name, address, and driving distance from the Site of:
 - 1) Manufacturer's sales representative.
 - 2) Nearest service center offering full array of service capabilities.
 - 3) Warehouse or other location where spare parts for the proposed substitute are available.
 - f. Number of years that manufacturer has actively participated the North American market.
- 2. Proposed Materials and Equipment:
 - a. Model designation and quantity of each proposed for the Work.
 - b. Manufacturer's literature for proposed substitute, with description of the materials and equipment.
 - c. Performance information and representative test data.
 - d. Indication of reference standards with which materials and equipment comply.
 - e. Preliminary process and instrumentation diagrams (P&ID), where applicable.
 - f. Identification of hazardous materials, including Constituents of Concern, used in the materials and equipment, and associated permitting or licensing required.
 - g. Manufacturer's standard warranty and applicable, proposed special or extended warranties, including indication of specific entities that will be beneficiary of such warranties.
 - h. Complete list of proposed deviations from requirements of the Contract Documents.
 - i. Itemized comparison of specified materials and equipment and proposed substitute, indicating:

- 1) Size (physical dimensions) when: item is in use, when not in use, and space required for routine and major maintenance.
- 2) Weight and loading at supports, when item is full and empty.
Materials of construction.
3. Operation requirements, including:
 - a. Anticipated consumption of each item of: Electricity, other energy sources, water, chemicals (indicate each), and other needs for operation at the Site.
 - b. Typical labor required for operation and associated skill level.
 - c. Description of remote monitoring and control capabilities, as applicable.
4. Maintenance requirements, including:
 - a. Anticipated life in the service and environment required.
 - b. Frequency and general scope of routine and major maintenance typically necessary.
 - c. Typical labor requirements and general qualifications of personnel performing routine maintenance.
 - d. Major, associated equipment necessary for routing and major maintenance, including hoisting equipment type and capacity (when applicable).
 - e. Availability, scope, cost, and general conditions of service and maintenance contracts, if any.
5. References for similar projects on which the materials and equipment were used. Indicate for each:
 - a. Project owner name, name of facility where installed, and name of project.
 - b. City, state, and country of installation.
 - c. Model number/size and quantity furnished and installed.
 - d. Year of installation.
 - e. Contact information for owner and design professional, including telephone numbers.
6. Other information required by the Contract Documents.
7. Other information reasonably requested by Engineer.

1.5 SUBSTITUTE CONSTRUCTION METHODS, PROCEDURES, OR SEQUENCES

- A. Provisions of the General Conditions, as may be modified by the Supplementary Conditions, regarding substitutes of materials and equipment are hereby extended to apply to substitute methods, procedures, and sequences as shown or indicated in the Contract Documents.
- B. In addition to other requirements of this Section and elsewhere in the Contract Documents, substitution requests for substitute methods, procedures, or sequences shall include:
 1. Clear identification of the method, procedure, or sequence shown or indicated in the Contract Documents for which substitute is requested.
 2. Detailed description of proposed substitute method, procedure, sequence, or combination thereof.
 3. Reasons why substitute is proposed and benefits to the Project should the substitute be approved.
 4. Detailed list of how the proposed substitute deviates from associated method, procedure, or sequence shown or indicated in the Contract Documents.
 5. Impact of the substitute, if approved, on Owner's or facility manager's operations, when the Work is at an existing facility.
 6. Effect on other contractors working at the Site, if substitute is approved.
 7. Description of temporary equipment and temporary facilities needed, should the substitute be approved, including quantity of items, capacities, performance characteristics, permitting and approvals required by authorities having jurisdiction, and proposed location at the Site.
 8. Written evaluation of how substitute method, procedure, or sequence complies with Laws and Regulations.
 9. Drawings illustrating method, procedure, or sequence.
 10. Materials to be used that contain Constituents of Concern or that have potential to cause or exacerbate a Hazardous Environmental Condition.
 11. Other information and data required by the Contract Documents.

12. Other information reasonably required by Engineer.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The following, bound after this Section's "End of Section" designation, are part of this Specifications Section:
1. Exhibit A - Substitution Request Form (one page).

END OF SECTION

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SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

1.1 SUMMARY

A. Section Includes:

1. This Specifications section expands upon provisions of the General Conditions, as may be modified by the Supplementary Conditions, and includes:
 - a. Requests for interpretation.
 - b. Written clarifications.
 - c. Minor changes in the Work and Field Orders.
 - d. Work Change Directives.
 - e. Proposal Requests.
 - f. Change Proposals.
 - g. Change Orders.

1.2 GENERAL – APPLICABLE TO ALL PROVISIONS OF THIS SECTION

- A. Submit Contract modification documents to Engineer, addressed to the contact person and contact information indicated in Section 01 33 00 - Submittal Procedures, and in accordance with Section 01 31 26 - Electronic Communication Protocols.
- B. Retain at Contractor's office and at the Site complete copy of each Contract modification document, all interpretations and clarifications, related documents, and Engineer's response.

1.3 REQUESTS FOR INTERPRETATION

A. General.

1. Transmit written requests for interpretation to Engineer. Contractor and Owner may prepare and transmit requests for interpretation.
2. Prepare and transmit request for interpretation to obtain clarifications or interpretations of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents by requesting an interpretation.
3. Do not transmit request for interpretation when other form of communication is appropriate, such as Submittals, requests for approvals of substitutes, notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action by Engineer.
4. Do not submit request for interpretation or clarification when:
 - a. answer may be obtained by observations at the Site; or
 - b. required information is clearly indicated in the Contract Documents; or
 - c. required information is included in industry standards referenced in the Contract Documents or Supplier's instructions that are consistent with the Contract Documents; or
 - d. are reasonably inferable from any of foregoing.
5. Engineer will return requests for interpretation without response for any of the following reasons:
 - a. Request is regarding one of the items addressed in Paragraphs 1.3.A.3 and 4 of this Specifications section.
 - b. Request is unclear or incomplete.
 - c. Request was answered in Engineer's response to a prior request for interpretation.
 - d. Request is related to construction means, methods, techniques, procedures, or sequences of construction that are not required by the Contract Documents.
 - e. Request is related to safety and protection matters that are solely Contractor's responsibility.
 - f. Request resulted in whole or in part to lack of adequate coordination by Contractor, including coordination of Subcontractors and Suppliers.
 - g. Requests that are otherwise frivolous or unnecessary.

6. Should requests be categorized by Engineer as within the limits of Paragraphs 1.3.A.3, 4, or 5 of this Specifications Section, Engineer may recommend and Owner may withhold from payments due Contractor under the Contract set-off(s) sufficient to cover Owner's costs of Contractor's submittal of invalid, frivolous, unnecessary, or inappropriate requests for interpretation or clarification.
 7. Contractor shall have sole financial responsibility for Contractor's costs for requests for interpretation or clarification that are submitted late, out of sequence, or that are unnecessary.
- B. Procedure.
1. Transmit requests for interpretation in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Include with each request for interpretation a separate letter of transmittal.
 2. If Engineer requests additional information to make an interpretation, entity requesting the interpretation shall transmit the information requested within 10 days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.
 3. Engineer will review and respond to requests for interpretation with reasonable promptness. Allow sufficient time for review and response.
 4. Engineer will maintain log of requests for interpretation. Upon request, copy of log will be transmitted to requestor.
 5. Engineer's response to requests for interpretation will be transmitted in accordance with the Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each response to a request for interpretation will include a separate letter of transmittal.
 6. Engineer's response to each request for interpretation will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 7. If Contractor desires to appeal Engineer's interpretation or clarification, comply with the appeals procedure set forth in the General Conditions, as may be modified by the Supplementary Conditions.
 8. Interpretations that One or Both Parties Believes Entails a Change to the Contract:
 - a. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's interpretation, so advise Engineer in writing before proceeding with the Work associated with the request for interpretation.
 - b. If, after this initial communication, either Owner or Contractor believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
- C. Preparation of Requests for Interpretation:
1. Prepare each request for interpretation on the "Request for Interpretation" form included with this Specifications section, or other form acceptable to Engineer.
 2. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract WWTP09" would be, "RFI No. WWTP09-GC-001".
 3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail to describe the need for interpretation.
 4. When applicable, request for interpretation shall include Contractor's recommended resolution.

1.4 WRITTEN CLARIFICATIONS

A. General:

1. Written clarifications, when required, will be initiated and issued by Engineer.
 2. Written clarifications do not change the Contract Price or Contract Times, and do not alter the Contract Documents.
 3. Written clarifications will be issued as correspondence or using clarification notice form acceptable to Engineer, with additional information as required.
- B. Procedure.
1. Engineer's written clarifications will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section.
 2. Each written clarification will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 3. If Contractor desires to appeal Engineer's interpretation or clarification, comply with the appeals procedure set forth in the General Conditions, as may be modified by the Supplementary Conditions.
 4. Written Clarifications that One or Both Parties Believes Entails a Change to the Contract:
 - a. If Contractor or Owner believe that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's written clarification, so advise Engineer in writing before proceeding with the Work associated with the written clarification.
 - b. If, after this initial communication, either Owner or Contractor believes that change in the Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
 5. If Engineer's written clarification is unclear, prepare and transmit a request for interpretation in accordance with the Contract Documents.

1.5 MINOR CHANGES IN THE WORK AND FIELD ORDERS

- A. General:
1. Field Orders, when required, will be initiated and issued by Engineer.
 2. Field Orders authorize minor changes in the Work but do not change the Contract Price or Contract Times.
 3. Field Orders will be in the form of Engineers Joint Contract Documents Committee document EJCDC C-942, "Field Order".
 4. Engineer will maintain a log of Field Orders issued. Copy of Engineer's log of Field Orders will be transmitted to Contractor or Owner upon request.
- B. Procedure:
1. Field Orders will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Field Order will include a separate letter of transmittal.
 2. Each Field Order will be distributed to the following:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 3. Field Orders that One or Both Parties Believes Entails a Change to the Contract Price or Contract Times:
 - a. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of a Field Order, so advise Engineer in writing before proceeding with the Work associated with the Field Order.
 - b. If, after this initial communication, Contractor believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
 4. If the Field Order is unclear, submit request for interpretation.

5. If Owner disagrees with the Field Order, Engineer may issue a revised or amended Field Order, or a Change Order or Work Change Directive may be issued.

1.6 WORK CHANGE DIRECTIVES

A. General:

1. Work Change Directives, when issued, order additions, deletions, or revisions to the Work. When issued, Contractor shall promptly implement the changes ordered in the associated work Change Directive.
2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following agreement by the parties as to the Work Change Directive's effect, if any, on the Contract Price, Contract Times, or both.
3. Work Change Directives will be in the form of EJCDC C-940, "Work Change Directive".

B. Procedure.

1. Work Change Directives signed by Owner and Engineer will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Work Change Directive will include a separate letter of transmittal. Signed Work Change Directives will be transmitted to:
 - a. Contractor.
 - b. Owner.
 - c. Engineer.
 - d. Resident Project Representative.
2. Documentation of Costs:
 - a. Promptly following receipt of the Work Change Directive:
 - 1) Advise Engineer and Owner in writing of the anticipated quantity and types of construction equipment and machinery required or anticipated for the associated Work.
 - 2) Advise Engineer and Owner in writing of which construction equipment and machinery is owned by the Contractor or Subcontractor and which is, or will be, rented from an equipment rental firm.
 - 3) When construction equipment and machinery is rented from a rental firm, transmit to Engineer and Owner copy of the associated rental agreements(s) pertinent to the Work ordered by the Work Change Directive.
 - 4) For all construction equipment and machinery, indicate to Engineer and Owner whether each item is required only for the Work ordered by the Work Change Directive and whether each item is being, or will be, used for other Work on the Project or other projects for Owner.
 - 5) Advise Engineer and Owner in writing of information on anticipated temporary materials (including items such as temporary support of excavations, scaffolding, temporary barriers, temporary plates covering excavations, and other temporary materials) to the same extent as that required for construction equipment and machinery.
 - b. When basis of payment for Work ordered under a Work Change Directive will be paid as Cost of the Work plus a fee, or when otherwise required by Engineer, document for the Work performed under each separate Work Change Directive, for each day, the following:
 - 1) Number and labor classifications of workers employed and hours worked each day on the Work ordered via the Work Change Directive.
 - 2) Construction equipment used, including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used each day for the Work under the Work Change Directive. Indicate where the equipment was used for other Work under the Contract and idle time.

- 3) Temporary materials; furnish the same information as required for construction equipment and machinery. Where rental costs of such items approaches the purchase cost of such item, or when otherwise requested by Engineer, furnish evidence, satisfactory to Engineer, of the purchase price of such temporary materials.
 - 4) Consumables and similar materials used.
 - 5) Suppliers' receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
 - 6) Invoices and labor and equipment breakdowns for Subcontractors.
 - 7) Other information required by Owner or Engineer.
 - 8) Transmit such documentation as a Change Proposal promptly after such documentation is available to Contractor. Actively pursue Subcontractors and Suppliers for required documentation to promptly furnish required documentation to Engineer.
- c. Separately track and document Work performed in accordance with each Work Change Directive and Work performed under stipulated price methods of compensation (including lump sums and Unit Price Work).
 - d. Submit such information in a format acceptable to Engineer.
3. Documentation of Time:
 - a. General:
 - 1) Contractor will be entitled to change of Contract Times Work ordered by a Work Change Directive in accordance with the requirements of the General Conditions, as may be modified by the Supplementary Conditions.
 - 2) Contractor will be entitled to a change in Contract Times only when the Work ordered by the Work Change Directive is implemented promptly and affects the Contractor's ability to comply with the Contract Times.
 - b. Requirement Documentation: Submit the following as part of the Change Proposal documenting price-related impact of the Work ordered by the Work Change Directive:
 - 1) Statement on whether the subject Work affected Contractor's ability to comply with the Contract Times.
 - 2) If Contractor's ability to comply with the Contract Times was so affected, indicate the effect on each of the relevant Contract Times.
 - 3) Document that Contractor acted promptly and properly upon receipt of the Work Change Directive to promptly implement the Work ordered thereby.
 - 4) Time impact analysis for the affected Work, in accordance with Section 01 29 73 - Schedule of Values.
 - 5) Other time-related documentation required by Engineer.

1.7 PROPOSAL REQUESTS

- A. General:
 1. Proposal Requests may be initiated by Engineer or Owner.
 2. Proposal Requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal Requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
 3. Proposal Requests will be furnished using the "Proposal Request" form included with this Specifications section.
- B. Procedure:
 1. Proposal Requests will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Section. Each Proposal Requests will include a separate letter of transmittal.
 2. Each signed Proposal Request will be transmitted to the following:
 - a. Contractor.
 - b. Owner.

- c. Resident Project Representative (RPR).
- d. Engineer.
- 3. Transmit request for interpretation to obtain clarification of conflicts, errors, ambiguities, and discrepancies in Proposal Request.
- 4. Upon receipt of Proposal Request, Contractor shall prepare and transmit to Engineer a Change Proposal, in accordance with the Contract Documents, for the proposed Work described in the Proposal Request.

1.8 CHANGE PROPOSALS

A. General:

- 1. Prepare and transmit written Change Proposal to Engineer in response to each Proposal Request; or when Contractor believes a change in the Contract Price, Contract Times, both, or other change to the terms of the Contract is required; or to appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract.

B. Procedure:

- 1. Prepare and transmit Change Proposals within time limits indicated in the General Conditions, as may be modified by the Supplementary Conditions.
- 2. Submit only one Change Proposal for each change issue, unless Engineer requires additional information or clarification. Do not submit repeated Change Proposals for the same change issue. Rather, when Contractor is dissatisfied with Engineer's decision on a Change Proposal, recourse is set forth in the General Conditions, as may be modified by the Supplementary Conditions, and elsewhere in this Article.
- 3. Transmit Change Proposals in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Include with each Change Proposal all required supporting documentation and a separate letter of transmittal.
- 4. Engineer's Review and Requests for Additional Information:
 - a. Engineer will review and act on each Change Proposal in accordance with, and within the time limits indicated in, the General Conditions, as may be modified by the Supplementary Conditions.
 - b. When, Engineer requests additional information to render a decision, submit required information within five days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to the specific Change Proposal number.
 - c. Owner shall transmit to Engineer such comments, if any, that Owner has on the Change Proposal, within 10 days of Owner's receipt of the Change Proposal.
 - d. Engineer will render a written decision on the Change Proposal or take other action in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
 - e. Engineer's response to Change Proposals will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section, the General Conditions, and the Supplementary Conditions.
- 5. Engineer's response to each Change Proposal will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
- 6. If Change Proposal is recommended for approval by Engineer and is approved by Owner, a Change Order will be issued or, when applicable, an appropriate use of an allowance (already included in the Contract Price) will be authorized by Owner.

7. If parties do not agree on terms for the change, Owner or Contractor may file a Claim against the other, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
- C. Preparation of Change Proposals:
1. Each Change Proposal shall be submitted on the “Change Proposal” form included with this Specifications section, or other form acceptable to Engineer.
 2. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named “Contract No. 8” would be, “Change Proposal No. 8-GC-001”.
 3. In space provided on Change Proposal form:
 - a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for Engineer’s review and response. If a change item is submitted in response to Proposal Request, write in as scope, “In accordance with Proposal Request No.” followed by the Proposal Request number. Submit written clarifications, if any, to scope of change.
 - b. Submit justification for each proposed change. If change is in response to proposal request, write in as justification, “In accordance with Proposal Request No.” followed by the Proposal Request number.
 - c. Indicate the total change in the Contract Price and Contract Times for each separate change item included in the Change Proposal.
 4. Proposed Effect on Contract Price: Unless otherwise directed by Engineer, attach to the Change Proposal detailed breakdowns of pricing (Contractor’s cost and Contractor’s fee) including:
 - a. List of Work tasks to accomplish the change.
 - b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification. Where overtime is included, indicate the overtime hours, labor classifications, and associated overhead rates.
 - c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each. Indicate whether the construction equipment or machinery is owned by Contractor, Subcontractor, or leased from a rental firm; if leased, include with the Change Proposal a copy of the rental agreement. Indicate whether the construction equipment and machinery is already onsite and used for other activities, or whether it is required solely for the Work in the contemplated change. Indicate overtime hours budgeted, if any, and the associated cost rate for overtime compared with the straight-time rate.
 - d. Indicate temporary materials required, including description of extent, scope, and quality, and associated cost. Temporary materials include items such as temporary sheeting for support of excavations, scaffolding, temporary plates to cover open excavations, temporary barriers, and other temporary items. Indicate ownership or source of such items. Include copy of rental agreement if rented from a third-party rental firm in which neither Contractor nor any Subcontractor has a financial interest. Indicate intended duration of use for such items and purchase cost of such items.
 - e. Detailed breakdown of cost of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier’s written quotations. When requested by Engineer, submit quotes by multiple prospective Suppliers.
 - f. Breakdowns of each Subcontractors’ pricing, including labor, construction equipment and machinery, temporary materials, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees (e.g., overhead and profit). Breakdown of Subcontractors’ pricing shall be the same level of detail as that for Contractor.
 - g. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions under “Cost of the Work” provisions.
 - h. Other information required by Engineer.

- i. Contractor's fees (overhead and profit) applied to eligible Contractor costs and eligible Subcontractor costs.
5. Proposed Effect on Contract Times: Unless otherwise directed by Engineer, attach to the Change Proposal detailed information substantiating the proposed change in Contract Times, including:
 - a. Time impact analysis required by Section 01 29 73 - Schedule of Values.
 - b. Indication of whether the Work associated with the contemplated change will affect Contractor's ability to comply with the Contract Times.
 - c. Other time-related information requested by Engineer.

1.9 CHANGE ORDERS

A. General:

1. Change Orders will be recommended by Engineer (when required by the General Conditions) and will be signed by Owner and Contractor (subject to the General Conditions related to a party withholding its signature from a contractually-required Change Order), to authorize additions, deletions, or revisions to the Work, changes to the Contract Price, changes in the or Contract Times, changes to the terms of the Contract, or a combination thereof.
2. Change Orders will be in the form of EJCDC C-941, "Change Order".

B. Procedure.

1. Change Orders for signature by Contractor will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Change Order will include a separate letter of transmittal. Contractor shall print three originals of Change Order for Contractor's signature.
2. Contractor shall promptly sign each original Change Order and, within five days of receipt, deliver all originals to Engineer.
3. Engineer will sign each original Change Order and forward them to Owner.
4. After approval and signature by Owner, original Change Orders will be distributed as indicated below.
5. Original, signed Change Orders will be distributed as follows:
 - a. Contractor: One original.
 - b. Owner: One original.
 - c. Engineer: One original.
 - d. Resident Project Representative (RPR): One copy.
6. Upon Contractor's receipt of the fully-signed Change Order, promptly perform the Work ordered thereby in accordance with the Contract Documents and the Progress Schedule accepted by Engineer.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below and bound following this Specifications section's "End of Section" designation, are part of this Specifications section:
 1. Request for Interpretation form (one page).
 2. Proposal Request form (one page).
 3. Change Proposal form (one page).

END OF SECTION

REQUEST FOR INTERPRETATION

Owner: City of Ketchum and Sun Valley Water and Sewer District

Project Name: Ketchum / SVWSD WRF – Aeration Upgrades

Contractor: _____ RFI No. [____]

Date Transmitted: _____ Date Received: [____]

Date Response Requested: _____ Date Response Transmitted: [____]

Subject: _____ [____]

Specification Section and Paragraph: _____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: [____]

ENGINEER'S RESPONSE:

Signature: _____ Date: [____]

PROPOSAL REQUEST

Owner: City of Ketchum and Sun Valley Water and Sewer District

Project Name: Ketchum / SVWSD WRF – Aeration Upgrades

Proposal Request No.: _____ Date: [____]

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change: _____

TO CONTRACTOR: Please submit a complete Change Proposal for the proposed modifications described below. If the associated Change Proposal is approved, a Change Order or allowance authorization will be issued to authorize adjustment so the Contract. This Proposal Request is not a Change Order, Work Change Directive, Field Order, or an authorization to proceed with the proposed Work described below.

SCOPE OF PROPOSED CHANGE(S) IN THE WORK:

1. *[Title 1]:*
2. *[Title 2]:*
3. *[Title 3]:*

Attachments to this Proposal Request:

1. [None].

Proposal requested by: _____
HDR (Engineer)

Signature of Requestor: _____

CHANGE PROPOSAL

Owner: City of Ketchum and Sun Valley Water and Sewer District

Project Name: Ketchum / SVWSD WRF – Aeration Upgrades

Change Proposal No.: _____ Date: [____]

Submitted in Response to Proposal No.: _____

Contractor Name and No.: _____

Contractor: _____

Subject: _____

The following changes to the Contract are proposed:

SCOPE OF PROPOSED CHANGE TO CONTRACT: *(attach supporting information as required)*

1. [Title 1]:
2. [Title 2]:

JUSTIFICATION:

1. [Title 1]:
2. [Title 2]:

PROPOSED CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

We propose that the Contract Price and Contract Times be changed as follows:

For Contract Price, attach detailed cost breakdowns for Contractor and Subcontractors, Supplier quotations, and other information required.

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times. Submit supporting data, including time impact analysis for the Progress Schedule.

Description	Amount	Contract Times (days)	
		Substantial	Final
1. [Title 1]	\$0.00	0	0
2. [Title 2]	\$0.00	0	0
Total This Change Proposal	\$0.00	0	0

Changes to Milestones, if any: [____][____]

Contractor represents that supporting data attached to this Change Proposal are accurate and complete. The requested time or price adjustment indicated in this Change Proposal is the entire adjustment to which Contractor believes it is entitled as a result of the proposed change(s) indicated herein.

Change Proposal by: _____

Signature of Proposer: _____

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SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements for the Schedule of values, including:
 - a. Applicability.
 - b. General provisions for Schedules of Values.
 - c. Format, organization, and content of Schedule of Values.
- B. Related Requirements: Include but are not necessarily limited to:
 - 1. Section 01 26 00 - Contract Modification Procedures.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Schedule of Values and Payment – General:
 - 1. Contractor shall prepare and submit to Engineer for acceptance Schedule of Values that presents (as applicable): (a) an appropriate, detailed breakdown of the price of lump sum bid/pay items, and (b) an appropriate, detailed breakdown of the price of Work compensated on the basis of Cost of the Work plus a fee, and (c) lists bid/pay items of Unit Price Work. The total of all Work among the various bid/pay items shall equal the Contract Price.
 - 2. For each item of lump sum Work and Work compensated on the basis of Cost of the Work plus a fee, the Schedule of Values shall, establish in detail the portion of the Contract Price allocated to each component of such Work.
 - 3. Upon request of Engineer, promptly furnish data and information that substantiates and supports the amounts indicated in the Schedule of Values.
 - 4. Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer’s comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.
 - 5. Schedule of Values may be used, where appropriate, as a basis for negotiating price of changes, if any, in the Work.
- B. Applicability:
 - 1. Lump Sum Work:
 - a. For Work paid on a lump sum basis, progress payments will be on the basis of Work performed in accordance with the Contract Documents, for each line item in the Schedule of Values, as recommended to Owner by Engineer.
 - 2. Work Compensated on the Basis of Cost of the Work Plus a Fee:
 - a. Such Work will be paid, based on Engineer’s recommendation to Owner, based on documentation of eligible costs submitted by Contractor with progress payment requests, in accordance with the General Conditions (as may be modified by the Supplementary Conditions).
 - b. Schedule of Values accepted by Engineer will be used by Engineer in evaluating reasonableness of Contractor’s progress payment requests.
 - c. While the actual Cost of the Work plus applicable fee for a given line item in the Schedule of Values may vary somewhat from the scheduled amount of such line item, where actual Cost of the Work (plus fee) for such line item differs substantially from the scheduled amount of such line item indicated in the Schedule of Values, Engineer may refuse to recommend further payment for such line item, in accordance with the Contract Documents.
 - d. Nothing in the Schedule of Values accepted by Engineer changes the Guaranteed Maximum Price, if any.
 - 3. Unit Price Work:

- a. Breakdown of unit prices (whether in a Schedule of Values or elsewhere) into detailed cost or price components is not required.
- b. Unit Price Work will be measured for payment in accordance with the Contract Documents.

1.3 ADMINISTRATIVE PROCEDURES

- A. General Provisions for Schedules of Values:
 1. This Section augments requirements for the Schedule of Values, indicated in the General Conditions, as may be augmented by the Supplementary Conditions.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
 1. Submit to Engineer the Schedule of Values in the form and quantity required in Section 01 33 00 – Submittal Procedures.
 2. Content of Schedule of Values Submittals shall be in accordance with this Section.
 3. Timing of Submittals:
 - a. Preliminary Schedule of Values:
 - 1) Submit preliminary Schedule of Values within time limit indicated in the General Conditions.
 - b. Initial Acceptable Schedule of Values:
 - 1) Revise the preliminary Schedule of Values in accordance with Engineer’s comments.
 - 2) Contractor will not be eligible for progress payment until acceptable Schedule of Values is submitted in accordance with the Contract Documents.
 - 3) Submit the Schedule of Values acceptable to Engineer in accordance with the General Conditions.
 - c. Updates: Submit updated Schedule of Values when:
 - 1) The Contract Price has changed.
 - 2) Requested by Engineer

1.5 FORMAT, ORGANIZATION, AND CONTENT OF SCHEDULE OF VALUES

- A. Organization and Major Elements of Schedule of Values.
 1. Prepare Schedule of Values on the “progress estimate” or “continuation sheets”, as applicable, of the Application for Payment form.
 2. Include in Schedule of Values itemized list of Work for each major work area included in the Work, for each lump sum payment item included in the Contract.
 - 1) Contractor will not be eligible for progress payment until acceptable Schedule of Values is submitted in accordance with the Contract Documents.
 - 2) Contractor will not be eligible for progress payment until acceptable Schedule of Values is submitted in accordance with the Contract Documents.
 3. In addition, list either in the Schedule of Values or on a separate worksheet included with Applications for Payment all Unit Price Work bid/pay items in the Contract. The balance of this Article applies to lump sum Work and Work compensated on the basis of Cost of the Work plus a fee.
 4. Organization in Accordance with Specification Sections:
 - a. Within each work area, organize the Schedule of Values by the various Specifications section numbers and titles included in the Contract Documents.
 - b. Label each row in the Schedule of Values with the appropriate Specifications section number. Include an amount for each row in the Schedule of Values.
 - c. List sub-items of major materials, equipment, or systems, as appropriate or when requested by Engineer.
- B. Requirements for both the preliminary Schedule of Values Submittal and the Schedule of Values Submittal for Engineer’s acceptance are:
 1. Subcontracted Work:

- a. Schedule of Values shall indicate division of Work between Contractor and each Subcontractor.
- b. Line items for Work to be performed by each Subcontractor shall include the word, “(SUBCONTRACTED)” and the name of the Subcontractor once the associated subcontract is signed and effective.
2. Apportionment between Materials and Equipment, and Installation: Schedule of Values shall include separate apportionment of costs for:
 - a. Cost of materials and equipment to be incorporated into the completed construction.
 - b. Cost of delivery, handling, and storage of materials and equipment to be incorporated into the completed construction.
 - c. Cost of temporary materials (such as excavation supports, scaffolding, and other temporary materials), and their associated delivery, handling, and storage costs, if any.
 - d. Cost of rentals of construction equipment and machinery, whether owned by Contractor or Subcontractor or leased from a third-party equipment rental entity.
 - e. Cost of installing materials and equipment.
 - f. Travel and subsistence costs, if any.
 - g. Other costs used in preparing the Bid by Contractor and each Subcontractor.
3. Sum of individual line item amounts indicated on the Schedule of Values shall equal the total of associated bid/pay item. Sum of bid/pay item totals in the Schedule of Values, plus the sum of any separate listing of Unit Price Work items, shall equal the total Contract Price.
4. Overhead and Profit:
 - a. Include in each line item a directly proportional amount of Contractor’s overhead and profit in the Contract Price.
 - b. Do not include overhead and profit as separate line item(s).
5. Allowances: Include separate line item for each allowance.
6. Unit Price Work: Separately indicate items of Unit Price Work in the overall Schedule of Values. Where the required form (in accordance with Section 01 29 76 - Progress Payment Procedures) includes a separate worksheet or page for Unit Price Work, indicate all items of Unit Price Work on such worksheet or page of the form.
7. Bonds and Insurance Costs:
 - a. Include line item for bonds and insurance in bid/pay item, in amount not greater than 1.5 percent of the total Contract Price.
 - b. When greater than the amount stipulated immediately above is proposed by Contractor in the Schedule of Values, submit to Engineer documentation substantiating the proposed amounts. Submit to Engineer such documentation when otherwise requested by Engineer.
 - c. When Contractor has furnished performance and payment bonds and evidence of insurance acceptable to Owner and in accordance with the Contract Documents, entire amount for bonds and insurance may be applied for in the first Application for Payment.
8. Construction Support, Project Management, and Administrative Cost Elements:
 - a. Costs under this category are sometimes informally referred to as “field overhead”, but are Project costs rather than costs related to Contractor’s general business operations.
 - b. Include in the Schedule of Values relevant line items and amounts for work and services required by the General Conditions and specific Division 01 Specifications sections, such as:
 - 1) Project management costs.
 - 2) Onsite superintendence and supervision costs.
 - 3) Itemized list of Work by work area, as applicable, for costs associated with coordination with the Owner’s operations, including required sequencing, as set forth in the Contract Documents.
 - 4) Updating the construction Progress Schedule, preparing time impact analyses, and preparing recovery schedules. Preparation of preliminary Progress Schedule and

- the initial (“baseline”) Progress Schedule acceptable to Engineer are part of mobilization.
- 5) Construction progress photographic documentation. Preconstruction photographic documentation and final photographic documentation are, respectively, part of mobilization and demobilization.
 - 6) Updates of the Schedule of Submittals.
 - 7) Contractor’s safety representative and ongoing implementation of Contractor’s Site-specific health and safety plan (SSHASP). Establishing the SSHASP is part of mobilization.
 - 8) Ongoing compliance with permits (when applicable). Contractor’s securing of required work permits is part of mobilization.
 - 9) Ongoing cost for temporary utilities and temporary facilities. Establishing such services and facilities is part of mobilization.
 - 10) Ongoing costs for temporary security .
 - 11) Field offices (monthly rental and maintenance) and storage facilities (excluding costs of establishment and removal, which are part of mobilization and demobilization).
 - 12) Ongoing site maintenance, such as temporary controls (dust, air pollution, water pollution, solid waste control, pest and rodent control, temporary erosion and sediment controls, and others), snow and ice removal, and similar activities.
 - 13) Field engineering and surveying.
 - 14) Progress cleaning and cleaning for Substantial Completion.
 - 15) Record documents (preparation, maintenance, and submittal).
 - a) If adequate record documents are maintained, up to 50 percent of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
 - b) Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance with the Contract Documents.
 - c) If record documents submitted are unsatisfactory to Engineer, amount may be reduced via set-offs in accordance with the Contract Documents.
 - 16) Other items required by Engineer.
- c. Include such items in Applications for Payment on payment schedule acceptable to Engineer.
 - d. Such line items in the Schedule of Values shall exclude any and all costs associated with Contractor’s permanent place(s) of business, personnel stationed at permanent office(s), salaries and bonuses of executive and administrative personnel not directly performing work on the Project, and general business expenses, all of which are part of Contractor’s overhead costs.
9. Mobilization and Demobilization: In accordance with Section 01 71 14 - Mobilization and Demobilization.
 10. Mobilization and Demobilization:
 - a. Include separate line items under each appropriate lump sum bid/pay item for mobilization and demobilization.
 - b. Document for Engineer the activities included in mobilization and demobilization line items.
 - c. Mobilization includes:
 - 1) Obtaining Owner’s acceptance of proposed Subcontractors and Suppliers and entering into subcontracts and purchase orders needed to start the Work.
 - 2) Preparing and obtaining Engineer’s approval of Shop Drawings required in Section 01 14 19 - Use of Site.
 - 3) Preparing and obtaining Engineer’s acceptance of schedules, including Progress Schedule, Schedule of Submittals, and Schedule of Values.
 - 4) Preconstruction conference(s) required by the Contract Documents.
 - 5) Preconstruction photographic documentation.

- 6) Establishing Contractor's Site-specific health and safety plan, preconstruction activities needed to start implementing Contractor's safety programs, and verifying status of training of construction workers and personnel and condition of construction equipment, machinery, and tools.
 - 7) Submitting acceptable emergency contact information
 - 8) Obtaining required permits needed to start the Work.
 - 9) Initial establishment of temporary utilities and temporary facilities.
 - 10) Establishing Contractor's field office and sheds, Contractor's storage areas, staging and laydown areas, and other areas necessary to perform the Work.
 - 11) Initial establishment of construction vehicular access to the Site, parking needed for construction, and offsite haul routes.
 - 12) Establishing construction equipment, machinery, and tools at the Site.
 - 13) Providing initial temporary controls.
 - 14) Establishing temporary security needed to start Work at the Site.
 - 15) Other mobilization acceptable to Engineer.
- d. Mobilization will be limited to 4 percent of the Contract Price, and will be paid in two payments, each 50 percent of total amount for mobilization. Should Contractor propose mobilization in an amount greater than the limit indicated in this paragraph or on an alternative schedule from that indicated in this paragraph, submit to Engineer for acceptance information and documentation sufficient to support and substantiate the proposed amount and payment schedule for mobilization.
- a. Demobilization includes:
- 1) Removal from the Site and adjacent areas of excess materials and equipment.
 - 2) Removal of temporary controls, temporary facilities, temporary barriers, and similar materials and equipment.
 - 3) Removal of temporary access roads and parking areas not part of permanent pavement or otherwise allowed to remain by Owner, including temporary traffic controls established for construction vehicles and equipment.
 - 4) Removal of all field office and sheds, storage areas, staging and laydown areas, and other areas needed to perform the Work and restoration of such areas.
 - 5) Removal from the Site of all construction equipment, machinery, tools, Contractor's containers, temporary fuel storage tanks, and similar items.
 - 6) Closeout of permits on which Contractor is a permittee or co-permittee.
 - 7) Final cleaning.
 - 8) Furnishing required warranty bond, if any.
 - 9) Furnishing required closeout documents.
 - 10) Other costs and effort by Contractor for demobilization.
- b. Demobilization shall be not less than 2 percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to Engineer.
11. Costs for Submittals, field quality control activities, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:
- a. Submittals: Up to 8.0 percent of cost (including all associated overhead and profit) of each equipment item, exclusive of transportation and installation costs associated therewith, may be allocated to preparation of Shop Drawings, Samples, and other Submittals required for release for purchase, fabrication, or delivery (as applicable) and may be included in the Application for Payment following Engineer's approval of Shop Drawings (and acceptance of other Submittals, as applicable) required for fabricating or purchasing for that item for the Work.
 - b. Field Quality Control: Up to 3.0 percent of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to specified or required field quality control activities (including required testing and inspections) and included in the Application for Payment following Engineer's acceptance of the associated written field quality control report Submittal(s).

- c. O&M Manual Submittals and Training: Up to a total of 4.0 percent of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for the associated item.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for Contractor's progress payments.
- B. Scope:
 - 1. Contractor's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
 - 2. Form: Applications for Payment shall be the Engineers Joint Contract Documents Committee (EJCDC) document EJCDC C-620, "Contractor's Application for Payment" (2018 edition or later) or other form acceptable to the Owner and Engineer.

1.2 CONTENT AND PROCEDURE FOR REQUESTING PROGRESS PAYMENTS

- A. Procedure:
 - 1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment request. Application for Payment shall cover only the Work and quantities recommended by the RPR.
 - 2. Contractor will review with Engineer or RPR the status of Project record documents, in connection with Engineer's review of each Application for Payment. Failure to maintain record document current will be cause for Engineer to recommend a reduction in payment for record documents in accordance with Section 01 29 73 - Schedule of Values, and will entitle Owner to set-offs in accordance with the Contract Documents.
 - 3. Submit to Engineer one scanned original, each with Contractor's signature, of each complete Application for Payment and other documents to accompany the Application for Payment. Each Application for Payment shall be transmitted electronically in accordance with 01 31 26 - Electronic Communication Protocols.
 - 4. Engineer will act on request for payment in accordance with the General Conditions and Supplementary Conditions.
- B. Content: Each request for payment shall include:
 - 1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
 - 2. Documentation for Stored Materials and Equipment:
 - a. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions.
 - b. UCC-1 Financial Statement:
 - 1) For each lot or delivery of stored materials and equipment for which payment is requested prior to installation of the item(s) at the Site, complete UCC-1, "Financial Statement" form. On UCC-1 form, indicate Owner as "security party"; indicate Supplier as "debtor" when stored item(s) are in Supplier's custody, and indicate Contractor as "debtor" when stored item(s) are in Contractor's custody; and clearly indicate in detail all stored item(s) included in the filing as "collateral" on the form. Include attachments to the form when necessary to clearly and fully indicate in detail the associated "collateral".
 - 2) File completed UCC-1 form with the secretary of state in the state where the subject item(s) are stored.

- 3) Include with Application for Payment the completed UCC-1 form together with evidence of filing with the required state(s). Submit UCC-1 form and related documentation once for each lot or delivery of stored items.
 - c. Photographs of the stored items at the storage location, in accordance with requirements for progress photographs in Section 01 42 00 - References. Submit photographs sufficient to clearly indicate each stored item, clearly showing marking of Owner's property in accordance with Paragraph 1.3.C of this section. Such photographs do not count as photographs required under Section 01 42 00 - References. For each month that such item(s) are stored, take and submit monthly new photographs of each stored item, with date-stamp on each photograph.
 - d. Legibly indicate on invoice or bill of sale the specific stored materials or equipment included in the payment request and corresponding bid/payment item number for each and the Supplier price for each item.
3. For Payment on the Basis of Cost of the Work plus a Fee:
 - a. When Work included in an Application for Payment will be compensated on the basis of Cost of the Work plus a fee, whether when the entire Contract is compensated on the basis of Cost of the Work plus a fee or when the Application for Payment includes Change Order Work to be compensated on the basis of Cost of the Work plus a fee, the Application for Payment shall include documentation of the costs, including not less than the following:
 - 1) Number of and labor classifications of workers employed and hours worked. Separately indicate overtime and holiday hours, when applicable.
 - 2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work compensated on the basis of Cost of the Work. Where such equipment was used on overtime, separately indicate overtime hours.
 - 3) Consumables and similar materials used.
 - 4) Receipts, bills, or invoices for, and descriptions of, materials and equipment incorporated into the Work.
 - 5) Invoices and breakdowns of labor, construction equipment, and materials and equipment incorporated into the Work by Subcontractors, and Suppliers' onsite time, if any.
 - 6) Invoices or receipts for other expenses included in the Application for Payment, such as travel and subsistence expenses, costs for bonds and insurance, and all other eligible costs and expenses for which compensation is sought in the subject Application for Payment on the basis of Cost of the Work.
 - 7) Other information and documents required by Owner or Engineer,
 - b. Costs for which progress payment is requested on the basis of Cost of the Work plus a fee and for which documentation acceptable to Engineer is not submitted will not be eligible for payment.
 4. Listing of Subcontractors and Suppliers:
 - a. In accordance with the General Conditions, submit not less than monthly updated listing of all Subcontractors and Suppliers known to Contractor, whether or not such entities have a contract directly with Contractor.
 - b. Submit complete information using the form attached to this Specifications section.
 5. Allowance Work:
 - a. For payment requests that include payment for Work under an allowance, include with the progress payment request copy of Owner's authorization of the associated allowance Work.
 6. Partial Release or Reduction of Retainage:
 - a. For each Application for Payment where Contractor requests partial release or reduction of retainage in any amount (other than request for final payment), submit with associated progress payment request consent of surety to partial release or reduction of retainage, duly completed by Contractor and surety.

- b. Acceptable form includes AIA G707A, “Consent of Surety to Reduction in or Partial Release of Retainage” (1994 or later edition), or other form acceptable to Owner.
- c. For payment requests that include reduction in or payment of retainage in an amount greater than that required by the Contract Documents, obtain Owner’s concurrence for partial release or reduction in retainage prior to submitting such Application for Payment.

C. Final Payment:

- 1. Requirements for request for final payment are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19 - Closeout Requirements.

1.3 ADDITIONAL PROCEDURES FOR PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Observation of Stored Materials and Equipment as Condition Precedent to Eligibility for Payment:

- 1. General:
 - a. Prior to materials or equipment suitably stored but not yet incorporated into the Work can be eligible for payment, Engineer or Resident Project Representative (RPR) shall visit the storage location and verify the extent, condition, and storage environment of the stored items.
 - b. When the same material or equipment item is stored for more than two months, such visits to storage location shall be not less than once every two months.
- 2. Cost Responsibility for Observations:
 - a. When storage location is less than 20 miles from the Site or less than 20 miles from Engineer’s office, Contractor is not responsible for reimbursing Owner for cost of Engineer’s time and expenses for observing stored materials and equipment.
 - b. When storage location is more than 20 miles from the Site and more than 20 miles from Engineer’s office, Contractor shall reimburse Owner, via a set-off under the Contract Documents, for reasonable cost of Engineer’s time and expenses, including travel time, to visit the storage location and observe the stored materials and equipment.

B. Other Requirements for Stored Items: Regardless of storage location, perform the following for stored materials and equipment for which payment is sought:

- 1. Clearly mark each stored container, crate, or item as follows: “Property of Ketchum / SVWSD WRF” using permanent marking. Such marking shall not blemish or deface the finish of items that will be exposed to view after installation at the Site.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following this Specifications section’s “End of Section” designation, are part of this Specifications section:
 - 1. List of Subcontractors and Suppliers form (two pages).

END OF SECTION

LIST OF SUBCONTRACTORS AND SUPPLIERS

Owners: City of Ketchum, Idaho and Sun Valley Water and Sewer District
Project Name: Ketchum / SVWSD WRF – Aeration Upgrades

Contractor: _____ Date: _____
Contract Designation: _____

Indicate below complete information for each Subcontractor and Supplier known to Contractor, regardless of whether the firm has a direct contract with Contractor. Include all lower-tier Subcontractors and associated Suppliers. Copy and paste the paragraphs below as required to indicate all Subcontractors and Suppliers.

SUBCONTRACTORS

1. **Subcontractor Name:**

- Address:
- Contact Person:
- Telephone No.:
- E-mail Address:
- Work Under Specifications Section Nos.:
- Brief Description of Work:
- Current Subcontract Price:
- Approximate Subcontract Start Date:
- Approximate Subcontract End Date:

2. **Subcontractor Name:**

- Address:
- Contact Person:
- Telephone No.:
- E-mail Address:
- Work Under Specifications Section Nos.:
- Brief Description of Work:
- Current Subcontract Price:
- Approximate Subcontract Start Date:
- Approximate Subcontract End Date:

3. **Subcontractor Name:**

- Address:
- Contact Person:
- Telephone No.:
- E-mail Address:
- Work Under Specifications Section Nos.:
- Brief Description of Work:
- Current Subcontract Price:
- Approximate Subcontract Start Date:
- Approximate Subcontract End Date:

Total of Subcontract Prices for all subcontracts equals approximately _____ percent of the Contract Price (Contractor to fill in blank monthly)

SUPPLIERS

1. **Supplier Name:**

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

2. **Supplier Name:**

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

3. **Supplier Name:**

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

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SECTION 01 31 13
PROJECT COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements for:
 - a. Project coordination when the Project is implemented using a single prime construction Contract.
 - b. Coordination meetings.
 - c. Coordination drawings and layout drawings.
- B. Scope:
 - 1. Contractor shall coordinate the Work, whether performed by Contractor's employees or by Subcontractors, Suppliers, or others for whom Contractor is responsible, to provide Work in accordance with the Contract Documents.
 - 2. Coordinate the Work with testing entities and inspectors (whether hired by Contractor, Owner, or others) employed on the Project, forces of Owner and facility manager (if other than Owner), and other contractors retained by Owner or facility manager, and other entities with which the Work needs to be coordinated.
 - 3. Requirements for preconstruction meetings are in the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 31 19 - Project Meetings.
 - 4. Requirements for construction progress meetings are in Section 01 31 19 - Project Meetings.
- C. Related Requirements:
 - 1. Include, but are not necessarily limited to, the following:
 - a. Section 01 11 00 - Summary of Work.
 - b. Section 01 14 16 - Coordination with Owner's Operations.
 - c. Section 01 31 19 - Project Meetings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordination – General:
 - a. In accordance with the General Conditions as may be modified by the Supplementary Conditions, and Section 01 11 00 - Summary of Work, Contractor shall coordinate the Work with, and cooperate with, other contractors, utility owners and their contractors, owners of transportation facilities and their contractors, Owner's and facility manager's workers at the Site, and other entities working at or adjacent to the Site.
 - b. Comply with Section 01 14 16 - Coordination with Owner's Operations.
 - 2. Advise other contractors (if any) of schedule for the Work to allow other contractors sufficient time to perform their work that must be performed prior to the Work. Coordinate and communicate with other contractors and other entities when the Work must be performed prior to the work of others and make good-faith efforts to avoid delaying work of others.
 - 3. Coordination, Inspection, and Observation to Ensure Quality:
 - a. Contractor shall continuously inspect the Work throughout the Project to ensure that the Work complies with the Contract Documents.
 - b. Inspect (including testing, where required or necessary) substrates and surfaces on which the Work will be constructed, applied, adhered, or attached, to ensure substrate and surface conditions are appropriate for providing Work in accordance with the Contract Documents.
 - 4. Contractor is not responsible for, or liable for, damage or loss unless damage or loss resulted from action, inaction, or negligence of Contractor, or Subcontractor(s), Supplier(s), or other

entity for whom Contractor is responsible. This provision does not mitigate or reduce Contractor's responsibility for security for the Work, in accordance with the Contract.

B. Coordination Meetings:

1. Contractor's Coordination Meetings:
 - a. Schedule, attend, chair, and actively participate in coordination meetings deemed appropriate by Contractor for purposes of coordinating the Work of Contractor's employees, Subcontractors, Suppliers, and others for whom Contractor is responsible.
 - b. Frequency, location, date, time, and duration of Contractor's coordination meetings are at Contractor's discretion. Record and distribute to attendees and other members of Contractor's team a record of topics discussed, decisions made, and other relevant matters at Contractor's coordination meetings.
 - c. Engineer, Resident Project Representative (if any), Owner, and Owner's Site Representative (if any) will not attend Contractor's coordination meetings.
2. Coordination Meetings with Other Contractors:
 - a. When Section 01 11 00 - Summary of Work, indicates that others, whether or not under Owner's control, will be performing work at or adjacent to the Site, coordination meetings between the separate contractors may be necessary. When such meetings are deemed necessary by Owner, either Owner or Engineer will advise Contractor in writing of the location, date, time, duration, and frequency of such coordination meetings.
 - b. Such coordination meetings, when held, are anticipated to be once per month or less-often, and held either at the Site or in reasonable proximity to the Site. During periods when increased coordination among the separate projects is necessary, such as when adjacent contractors are in close proximity to each other, the potential exists that more-frequent coordination meetings may be necessary, although such increased frequency is not anticipated to be for extended periods.
 - c. Contractor's project manager and site superintendent shall attend such coordination meetings required by Owner.
 - d. Purpose of such coordination meetings will be to discuss scheduling and coordination of work by separate contractors and others as appropriate, sharing of space at the Site, and other coordination matters.
 - e. Owner and others deemed appropriate by Owner will attend such coordination meetings.
 - f. Owner or others for whom Owner is responsible will chair the meetings and prepare and distribute to participants a record of the topics discussed and decisions made at such meetings.

C. Coordination Drawings and Layout Drawings:

1. Maintain sufficient, competent personnel; drafting implements; computer-aided drafting/design (CAD) or building information modeling (BIM) equipment, software, systems; and supplies at Contractor's office and at the Site (as deemed appropriate by Contractor) for preparing layout drawings and coordination drawings.
2. With the Contract Documents and Shop Drawings, use coordination drawings and layout drawings for coordinating the Work of various trades.
3. Where such coordination drawings or layout drawings are to be prepared by Subcontractors such as structural-architectural, fire suppression, plumbing, HVAC, civil-site, process-mechanical, or other Subcontractors, ensure that each such Subcontractor maintains required personnel, implements, equipment, and systems at Subcontractor's office and at the Site (as deemed appropriate by Contractor).

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preconstruction, progress and other project meetings.
- B. Related Sections include but are not necessarily limited to:

1.2 PRECONSTRUCTION MEETING

- A. Meet with the Owner and Engineer for a pre-construction conference at a time mutually agreed upon after the contract is awarded, but before any work is performed,
- B. The Engineer will schedule a meeting of the Owner, Contractor, Contractor's Subcontractors, and their respective representatives.
 - 1. The purpose of the meeting will be to clarify construction contract administration procedures, to establish lines of authority and communication and identify duties and responsibilities of the parties.
- C. The Engineer will schedule the pre-construction conference after receipt of the Contractor's draft proposed schedule.
- D. Agenda:
 - 1. Procedural and Administrative:
 - a. Personnel and Teams:
 - 1) Designation of roles and personnel.
 - 2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
 - 3) Subcontractors and Suppliers in attendance.
 - 4) Authorities having jurisdiction.
 - b. Procedures for communications and correspondence, including electronic communication protocols.
 - c. Copies of the Contract Documents and availability.
 - d. The Work and Scheduling:
 - 1) General scope of the Work.
 - 2) Contract Times, including Milestones (if any).
 - 3) Phasing and sequencing.
 - 4) Preliminary Progress Schedule.
 - 5) Critical path activities.
 - e. Safety:
 - 1) Responsibility for safety.
 - 2) Contractor's safety representative.
 - 3) Emergency procedures and accident reporting.
 - 4) Emergency contact information.
 - 5) Confined space entry permits.
 - 6) Hazardous materials communication program.
 - 7) Impact of Project on public safety.
 - f. Permits.
 - g. Review of insurance requirements and insurance claims.
 - h. Coordination:
 - 1) Coordination of Subcontractors and Suppliers.
 - 2) Construction coordinator (for projects with multiple prime construction contracts).
 - 3) Coordination with Owner's operations.

- 4) Progress meetings – schedule and frequency.
- 5) Coordination meetings.
- i. Submittals:
 - 1) Current critical Submittals:
 - a) Preliminary Schedule of Submittals.
 - b) Other schedules (Progress Schedule, Schedule of Values).
 - c) Preconstruction photographic documentation.
 - d) List of proposed Subcontractors and Suppliers.
 - e) List of emergency contact information.
 - f) Notice of elements of Contractor’s safety program with which Owner and Engineer are to comply.
 - g) Site use plan.
 - h) Form of Contractor’s site superintendent’s daily reports.
 - 2) Work not eligible for payment without approved or accepted Submittals (as applicable).
 - 3) Submittal procedures.
 - a) Compliance with accepted Schedule of Submittals.
 - b) Actions required of Contractor prior to furnishing Shop Drawings and other Submittals.
 - c) Contractor’s Submittal approval stamp required; Contractor’s coordination of Submittals.
 - d) Furnishing of Submittals.
 - e) Submittal types and meaning of Engineer’s action on each.
 - f) Resubmittals—responsibility for, limitations on quantity.
 - 4) Identification of initial, critical Shop Drawings and product data.
 - 5) Construction photographic documentation.
- j. Substitutes and "Or-Equals":
 - 1) Product options.
 - 2) Procedures for proposing "or-equals".
 - 3) Procedures for proposing substitutes.
- k. Contract Modification Procedures:
 - 1) Requests for interpretation.
 - 2) Written clarifications.
 - 3) Field Orders.
 - 4) Proposal Requests.
 - 5) Change Proposals.
 - 6) Work Change Directives.
 - 7) Change Orders.
 - 8) Differing site conditions or discovery of Hazardous Environmental Condition.
 - 9) Substantiating and documenting Change Proposals and Claims.
 - 10) Claims.
- l. Progress Payment:
 - 1) Owner’s Project financing and funding, as applicable.
 - 2) Owner’s tax-exempt status.
 - 3) Preliminary Schedule of Values
 - 4) Procedures for measuring for payment (Unit Price Work).
 - 5) Retainage.
 - 6) Progress payment procedures; documents to accompany Applications for Payment.
 - 7) Payment for stored items not yet installed.
 - 8) Date of Owner’s payments; payment is due.
- m. Subcontractors and Suppliers:
 - 1) List of proposed Subcontractors and Suppliers; monthly updates.
 - 2) Coordination and management.
 - 3) Subcontracts and purchase orders.
 - 4) Diversity Business Enterprises (MBE, WBE, DBE, VBE, etc.) – when applicable:

- a) Goals.
 - b) Progress reports.
 - c) Requests for waivers.
- n. Testing and inspections:
 - 1) Owner-hired and contractor-hired.
 - 2) Identification of Owner-hired testing entity and special inspectors.
 - 3) Responsibility for advising testing entity and special inspectors of need for services.
 - 4) Results of code-required special inspections and tests.
 - 5) Prompt remedy of apparent defects.
 - 6) Notice of defective Work.
 - 7) Remedy of defective Work.
 - 8) Defective Work not eligible for payment.
 - 9) Covering up defective Work.
 - 10) Cost responsibility for defective Work and retesting/re-inspection.
- o. Disposal of demolition materials.
- p. Record documents.
- q. Preliminary discussion of Contract closeout:
 - 1) Procedures for Substantial Completion.
 - 2) Partial utilization procedures; property insurance.
 - 3) Contract closeout requirements.
 - 4) Correction period; duration of Contractor's general warranty and guarantee.
 - 5) Duration of bonds and insurance.
- 2. Authorities Having Jurisdiction (if not covered in a separate meeting):
 - a. Municipal licenses.
 - b. Municipal permits required.
 - 1) Permits required and status.
 - 2) Inspections for building code official.
 - 3) Code-required special inspections and tests (if not covered in Administrative and Procedures part of meeting).
 - c. Right-of-way work permits; status of occupancy permit(s).
 - d. Environmental permits:
 - 1) Spill prevention control and countermeasures plan (40 CFR 112).
- 3. Site Mobilization (if not covered in a separate meeting):
 - a. Working days, working hours, and overtime.
 - b. Use of Site and other areas; use of existing facilities.
 - c. Field offices, storage trailers, and staging areas.
 - d. Temporary facilities.
 - e. Temporary utilities and limitations on utility use (where applicable).
 - f. Utility company coordination (if not done as a separate meeting).
 - g. Access to Site, access roads, and parking for construction vehicles.
 - h. Traffic controls.
 - i. Temporary controls:
 - 1) Erosion and sediment control; storm water pollution prevention plans.
 - 2) Dust control and air pollution control (including emissions control).
 - 3) Water control (storm water, surface water, groundwater).
 - 4) Water pollution control; spill prevention control and countermeasures plan.
 - 5) Solid waste control.
 - 6) Pest control.
 - 7) Other temporary controls.
 - j. Security; temporary security fencing (where required).
 - k. Storage of materials and equipment to be incorporated into the Work.
 - l. Protection of the Work and property; protective barriers.
 - m. Field engineering:
 - 1) Reference points and benchmarks.

- 2) Surveys and layouts.
 - 3) Professional services for Contractor's means and methods (not delegated design).
 - 4) Contractor's site superintendent's daily records and submittal requirements.
 - n. Site maintenance during the Project:
 - 1) Progress cleaning; removal of trash and debris.
 - 2) Maintenance and cleaning of existing access roads and parking areas.
 - o. Restoration.
 - 4. Next meeting.
 - 5. Site visit, as necessary.
- E. The Engineer will compile meeting minutes from the transcribed record of the meeting and electronically distribute copies to all participants.
- F. Pre-Construction Conference Submittals:
- 1. The names and telephone numbers of Contractor's Superintendent and Office Manager.
 - 2. List of personnel authorized to sign change orders and receive progress payments.
 - 3. The name, address and telephone numbers of two or more persons employed by the Contractor who can be reached at any time of the day or night to handle emergency matters.
 - 4. A list of all subcontractors that will work on the project, a description of work they will perform, and a contact list for each subcontractor with phone numbers and address.
 - 5. A list of materials suppliers and products over \$2,500.
 - 6. A draft proposed Construction Schedule.
 - 7. Material Safety Data Sheets for all hazardous chemical products to be used by the Contractor on this project.
 - 8. Temporary Erosion and Sediment Controls Plan.
 - 9. Traffic Control Plan.

1.3 PROGRESS MEETINGS

- A. Monthly progress meetings will be held a location determined by the Engineer, unless otherwise arranged.
- B. Attendees will include the Owner, Engineer, Contractor, subcontractors, and suppliers' representatives as may be needed, other Contractors working at the site, and other interested or affected parties.
- C. Preliminary Agenda: Be prepared to discuss in detail the topics indicated below. Revised agenda, if any, will be furnished to Contractor prior to associated progress meeting(s). Progress meeting agenda may be modified by Engineer during the Project as necessary.
 - 1. Review, comment, and amendment (if necessary) of minutes of previous progress meeting.
 - 2. Review of progress since the previous progress meeting.
 - 3. Planned progress through next progress meeting.
 - 4. Review of Progress Schedule:
 - a. Review of the Contract Times; Contractor's ability to comply with Contract Times.
 - b. Identification of critical path activities.
 - c. Schedules for fabrication and delivery of materials and equipment.
 - d. Corrective measures, if necessary, including recovery schedule(s).
 - 5. Submittals:
 - a. Review status of critical Submittals.
 - b. Review revisions to Schedule of Submittals.
 - 6. Contract Modifications:
 - a. Requests for interpretation.
 - b. Written clarifications.
 - c. Field Orders.
 - d. Proposal Requests.
 - e. Change Proposals.
 - f. Work Change Directives.
 - g. Change Orders.

- h. Claims.
 - 7. Applications for progress payments:
 - a. Status and deadline for submittal.
 - b. Stored materials and equipment; observation by Engineer or RPR; documents required.
 - c. Set-offs to which Owner is entitled (as applicable).
 - d. Other matters related to progress payments.
 - 8. Problems, conflicts, and observations.
 - 9. Quality standards, testing, and inspections.
 - 10. Coordination between Project participants.
 - 11. Site management issues, including vehicular access and parking, traffic control, security, status of temporary controls and temporary utilities, site maintenance and cleaning, and other Site matters.
 - 12. Safety and protection.
 - 13. Permits.
 - 14. Construction photographic documentation.
 - 15. Record documents status.
 - 16. Completion matters (as appropriate):
 - a. Status of checkout, startup, field quality control activities.
 - b. Status of training of facility O&M personnel and O&M manuals.
 - c. Partial utilization; inspection for Substantial Completion.
 - d. Punch list status (as applicable).
 - e. Other closeout matters (if any).
 - 17. Other business.
- D. Bring a four-week look ahead schedule to each meeting, including the following items:
- 1. Work completed last week.
 - 2. Work anticipated for the next two weeks ("Look Ahead").
 - 3. Subcontractors on site the prior week.
 - 4. Subcontractors scheduled on site for the next two weeks.
 - 5. Contract document deficiencies or questions noted during prior week.
 - 6. Anything that could impede the progress of the work or affect the critical path on the project schedule.
 - 7. Corrective measures and procedures planned to regain planned schedule, cost or quality assurance, if necessary.
 - 8. Report of any accidents, and any site safety issues that need to be addressed.
- E. Other Agenda items to be discussed:
- 1. Review and revise as necessary and approve minutes of previous meetings.
 - 2. Status of submittals of equipment and shop drawings.
 - 3. Identify problems that impede planned progress.
 - 4. Other current business.
- F. Revision of Minutes:
- 1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, they will be accepted as properly stating the activities and decisions of the meeting.
 - 2. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
 - 3. Challenge to minutes shall be settled as priority item of "old business" at the next regularly scheduled meeting.
- G. Minutes of Meeting:
- 1. The Engineer will compile minutes of each project meeting and will furnish electronic copies to the Contractor.

1.4 OTHER MEETINGS

- A. Other meetings will be required to facilitate progress of the Work. These include, but are not limited to the following:
1. Pre-Installation Conferences:
 - a. Coordinate and schedule with Engineer for each material, product or system specified.
 - 1) Conferences to be held prior to initiating installation, but not more than two weeks before scheduled initiation of installation.
 - 2) Conferences may be combined if installation schedule of multiple components occurs within the same two week interval.
 - 3) Review manufacturers recommendations and Contract Documents Specification Sections.
 2. Facility Startup Planning and Coordination Meeting. See Section 01 75 00.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 31 26
ELECTRONIC COMMUNICATION PROTOCOLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Procedures with which Users will comply regarding transmission or exchange of Electronic Documents for the Project.
- B. Related Requirements:
 - 1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, regarding transmitting Electronic Documents by Electronic Means.
 - 2. In addition to the requirements of this Specifications Section, comply with the requirements for Electronic Documents in the following Specifications:
 - a. Section 01 33 00 – Submittal Procedures.
 - b. Section 01 42 00 - References.

1.2 DEFINITIONS

- A. The following terms are defined for use in this Specifications Section and are indicated herein using initial capital letters. The terms have the associated meaning regardless of whether indicated in singular or plural.
 - 1. Electronic Documents Protocol (abbreviated as “EDP”): Procedures and requirements set forth in this Specifications Section for the exchange of Electronic Documents by Electronic Means.
 - 2. Project Website: An internet-based software platform, such as a website or other project management information system (PMIS) designated by Contract or mutual consent of Users as the means of exchanging Electronic Documents during the Project.
 - 3. System Infrastructure: Hardware, operating system(s) software, internet access, e-mail service and software, security software, and large-file transfer functions.
 - 4. Users: Owner, Contractor, Engineer, and others exchanging Electronic Documents on the Project in accordance with the EDP.

1.3 ADMINISTRATIVE REQUIREMENTS.

- A. Coordination:
 - 1. Contractor shall require all Subcontractors and Suppliers to comply with the EDP established in the Contract Documents.

1.4 GENERAL PROVISIONS OF ELECTRONIC DOCUMENT PROTOCOL

- A. EDP – General:
 - 1. To the fullest extent practical, Users agree to and will transmit and accept Electronic Documents transmitted by Electronic Means in accordance with the requirements of this Specifications Section. Use of the Electronic Documents and any information contained therein is subject to requirements of this Specifications Section and other provisions of the Contract Documents governing transmittal of Electronic Documents.
 - 2. Content of Electronic Documents will be the responsibility of transmitting User.
 - 3. Unless otherwise provided in: (1) the EDP, (2) elsewhere in the Contract Documents, or (3) or other agreement between two or more Users governing use of Electronic Documents, Electronic Documents exchanged in accordance with the Contract Documents may be used in the same manner as paper or other printed versions of the same documents exchanged using other than Electronic Means, subject to the same governing requirements, limitations, and restrictions set forth in the Contract Documents.

4. Except as otherwise explicitly indicated in the EDP, the terms of this EDP will be incorporated into any other agreement or subcontract between a party and a third party for a portion of the Work or Project-related services, where such third party is, either directly or indirectly, required to exchange Electronic Documents with Owner, Contractor, or Engineer. Nothing in this EDP modifies the requirements of the Contract Documents regarding communications between and among Owner, Contractor, and Engineer Subcontractors, Suppliers, consultants, and others for which each is responsible.
 5. When transmitting Electronic Documents, transmitting User makes no representations regarding long-term compatibility, usability, or readability of the items resulting from the receiving User's use of software applications or System Infrastructure differing from those established in this EDP.
 6. This EDP does not negate or mitigate any obligation: (1) in the Contract Documents to create, provide, or maintain an original paper record version of Drawings and Specifications, signed and sealed in accordance with Laws or Regulations; (2) to comply with Laws and Regulations governing signing and sealing of design documents or signing and electronic transmission of other documents; or (3) to comply with notice requirements of the General Conditions (as. May be modified by the Supplementary Conditions).
 7. Modifications to EDP:
 - a. When modifications to the EDP are necessary to address issues affecting System Infrastructure, Users shall cooperatively resolve the issues.
 - b. If resolution within a reasonable time is not achieved, Owner is empowered to require reasonable and necessary changes to the EDP consistent with the original intent of the EDP.
 - c. If such changes result in additional cost or delay to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in the Contract Price, Contract Times, or both in accordance with the Contract Documents.
- B. System Infrastructure and Systems for Exchanging Electronic Document:
1. Each User will provide System Infrastructure (as defined in this EDP) at its own cost and sufficient for complying with EDP requirements. Except for minimum standards set forth in this EDP, it is the obligation of each User to determine, for itself, such User's own System Infrastructure.
 - a. Maximum size of e-mail file attachment under this EDP is 20 megabytes (MB). Attachments larger than the maximum size indicated in this paragraph shall be exchanged via secure electronic transfer using method mutually acceptable to Owner, Engineer, and Contractor.
 - b. Each entity transmitting or receiving Electronic Documents has full responsibility for its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, and otherwise enabling its System Infrastructure for use in accordance with this EDP.
 - c. Each User will provide its own printing facilities and will be responsible for its own costs of printing Electronic Documents.
 2. Each User is responsible for its own system operations, security, back-up, archiving, audits, and other technology and resources for operations of its System Infrastructure during the Project, including coordination with the User's individual(s) or subcontractor(s) responsible for managing its System Infrastructure and capable of addressing communications and other technology issues affecting exchange of Electronic Documents.
 3. Security:
 - a. Each User will operate and maintain industry-standard, industry-accepted, ISO standard, commercial-grade security software and systems to protect against threats including software viruses and other malicious software including worms, trojans, adware; data breaches; loss of confidentiality; and other threats in transmission to, or storage of, Electronic Documents from other Users, including transmission of Electronic Documents by physical media including flash drives/thumb drives, hard

- drives, compact discs (CD), digital video discs (DVD), and other portable devices, whether connected physically or wirelessly.
- b. To the extent that a User maintains and operates such security software and appropriate System Infrastructure, such User will not be liable to other Users participating in the Project for breach of system security.
4. Archiving and Electronic Document Backup:
 - a. Each User is responsible for its own back-up and archive of Electronic Documents and data transmitted and received during the Project, unless this EDP establishes a Project Electronic Document archive, either as a mandatory Project Website or other communications protocol, upon which Users may rely for Electronic Document archiving for the duration of the Project Website or archiving system established in this EDP.
 - b. Each User is solely responsible for its own post-Project back-up and archive of Electronic Documents after the Project is complete or after termination of the Project Website or other Project archive (as applicable), for the longer of: (1) required by the Contract Documents, (2) required by Laws and Regulations, and (3) as each User deems necessary for its purposes.
 5. Receipt of Damaged, Incomplete, or Corrupt Electronic Documents: When a receiving User receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving User will advise the transmitting User of the incomplete transmission and transmitting User will retransmit the Electronic Document.
 6. Completion of Transmittals: Users will bring non-conforming Electronic Documents into compliance with the EDP. Users will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the transfer of the Electronic Documents.
 7. Project Website:
 - a. Contractor will establish, operate, and maintain a Project Website (as defined in this EDP) for use of Owner, Engineer, Contractor, and other Users as appropriate during the Project, for exchanging and storing Project Electronic Documents.
 - b. Unless otherwise provided in the Contract Documents, use of Project Website by Owner, Contractor, and Engineer is mandatory for exchanging Project documents as set forth in the EDP.
 - c. Project Website Conditions and Standards:
 - 1) Software Platform: Contractor shall utilize their standard software platform, provided it conforms to the standards provided in this Section.
 - 2) Duration of Project Website Availability and Reliance by Users: Duration of Contract Times.
 - 3) Services and Functions Available on Project Website: Large-file transfer, project team contact information, electronic document archiving.
 - d. Address of Project Website will be furnished to Contractor, and Project Website will be available to Owner and Engineer, within 10 days following the Effective Date of the Contract.
- C. General Requirements and Limitations for Software for Electronic Document Exchange:
1. Software and file formats for exchange of Electronic Documents shall be as indicated in Article 1.5 of this Specifications Section.
 2. Software Versions:
 - a. Each User will acquire the software and associated licenses necessary to create, transmit, receive, read, and use Electronic Documents for the Project, using the software and file formats indicate in Article 1.5 of this Specifications Section.
 - b. Prior to using any updated version of the software required in the EDP for Electronic Document(s) transmitted to other User(s), the originating User will first notify and either (1) receive concurrence from receiving User(s) for use of the updated version, or (2) adjust its transmission to comply with the EDP.
 3. Preservation of Intellectual Property and Confidentiality of Electronic Documents:

- a. Users agree to not intentionally edit, reverse-engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes Electronic Documents, and information and data contained therein, transmitted in a file format, including portable document format (PDF), intended by transmitting User to not be modified, unless the receiving User (1) obtains permission from owner of the Electronic Document and intellectual property contained therein, or (2) is expressly allowed by the EDP to edit or modify the Electronic Document.
 - b. Where modifying, editing, decryption, or reverse-engineering is allowed by the EDP, such use is conferred only for the Project.
 - c. The EDP does not transfer any ownership or rights of any sort regarding use outside of the Project of Electronic Documents.
 - d. Users shall not cite or quote excerpts of Electronic Documents for purposes outside of the Project unless required to do so by Laws and Regulations.
- D. Contractor's Requests for Electronic Documents in Other Formats:
- 1. Release of Electronic Documents in format(s) other than those indicated in in Article 1.5 of this Specifications Section and elsewhere in the Contract Documents will be at the discretion of Owner and subject to terms and conditions required by the owner of such files and documents, and the provisions indicated below.
 - 2. To extent determined by Owner, in its sole discretion, to be appropriate, release of Electronic Documents in alternative format(s) requested by Contractor ("Request") are subject to provisions of Owner's response to the Request and to the following:
 - a. Contractor's Request shall be in writing. Owner and others, as appropriate, will consider and respond to Request promptly, but neither Owner nor Engineer will be responsible for any time or cost impacts on Contractor associated with timing of the Request, or with Owner's decision associated therewith.
 - b. When Engineer is the owner of the Electronic Documents requested by Contractor in native format, prior to Engineer transmitting such Electronic Documents to Contractor, Contractor shall sign and deliver to Engineer, without modifying or amending, Engineer's "Electronic Media Release" agreement.
 - c. Content included in Electronic Documents created by Engineer and furnished in response to the Request was prepared by Engineer as an internal working document for Engineer's purposes solely and, when provided to Contractor, is on an "as-is" basis without warranties of any kind, including, but not limited to any implied warranties of fitness for purpose. Contractor acknowledges that content of Electronic Documents furnished in response to the Request may not be suitable for Contractor's purpose(s), or may require substantial modification and independent verification by Contractor. Content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other shown or indicated information that may affect subsequent use by Contractor or others for whom Contractor is responsible.
 - d. Electronic Documents containing text, graphics, metadata, or other types of data furnished by Engineer in response to the Request are only for Contractor's convenience and any and all conclusions or information obtained or derived from such Electronic Documents will be at Contractor's sole risk and expense. Contractor waives any and all claims against Engineer, Owner, or both arising from Contractor's use of Electronic Documents furnished in response to the Request.
 - e. Contractor shall indemnify and hold harmless Owner, Engineer, and their respective consultants and subconsultants from any and all claims, damages, losses, and expenses, including attorneys' fees and defense costs, fees and costs of engineers, architects, geologists, accountants, and other professionals, and any and all other costs, direct and indirect, resulting from Contractor's use, adaptation, or distribution of Electronic Document(s) furnished in response to the Request.

- f. Contractor shall not sell, copy, transfer, forward, give away or otherwise distribute the Electronic Documents (in source format or modified file format) to any third party without direct written authorization of Engineer or other entity that owns the Electronic document(s), unless such distribution is specifically indicated in the Request and is limited to Subcontractors and Suppliers. Contractor warrants that subsequent use by Subcontractors and Suppliers complies with terms and conditions of the Contract Documents, Owner’s response to the Request, and release agreement(s) (if any) by owner of the Electronic Documents (including Engineer, where applicable).
3. When the Request is for Electronic Documents in a format not other than that indicated in the Contract Documents, and Owner (and others, as applicable) decide to comply with the Request, and when the requested Electronic Documents are not easily available in the format(s) requested, Contractor shall reimburse Owner for costs incurred by Owner, either directly or indirectly, to furnish Electronic Documents in accordance with the Request at a rate of \$200 per labor-hour to furnish the requested format(s). In compensation, Owner may retain such amount(s) as set-off(s) under the Contract Documents.

1.5 EXCHANGE OF ELECTRONIC DOCUMENTS

- A. Comply with the Electronic Document formats, transmission methods, and permitted uses set forth in Table 01 31 26-A, Exchange of Electronic Documents, below, when transmitting or using Electronic Documents on the Project. Where a row in the table has no indicated means of transmitting Electronic Documents, use for such documents only paper copies transmitted to the receiving party via appropriate delivery method.

TABLE 01 31 26-A – EXCHANGE OF ELECTRONIC DOCUMENTS

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
1.5.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C	EM, EMA	O, E, C	R	
Meeting notices and agendas	EM, PDF	E	PW	O, C	R	
Meeting minutes	PDF	E	PW	O, C	R	
1.5.A.2. Contractor's Submittals to Engineer						
Shop Drawings	PDF	C	PW	E	M (1)	(1)
Product data Submittals, delegated design Submittals, and other action Submittals (except Samples)	PDF	C	PW	E	M (1)	(1)
Informational and closeout Submittals:	PDF	C	PW	E	M (1)	(1) (6)
Documentation of delivery of maintenance materials Submittals	PDF	C	PW	E	M (1)	
1.5.A.3. Engineer's return of reviewed Submittals to Contractor						
Shop Drawings	PDF	E	PW	O., C	R	
Product data Submittals, delegated design Submittals, and other action Submittals	PDF	E	PW	O., C	R	
Informational and closeout submittals:	PDF	E	PW	O., C	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	PW	O. C	R	

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
1.5.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O	PW	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	PW	C, O	R	
Engineer's clarifications to Contractor	EM, PDF	E	PW	C, O	R	
Engineer's issuance of Field Orders	PDF	E	PW	C, O	R	
Proposal Requests	PDF	E, O	PW	C	R	
Change Proposals – submitted to Engineer	PDF	C	PW	O, E	S	
Change Proposals – Engineer's response	PDF	E	PW	C. O		
Work Change Directives (for Contractor signature)	PDF	E	PW	C	R	(2)
Change Orders (for Contractor signature)	PDF	E	PW	C	R	(2)
1.5.A.5. Applications for Payment						(3)
1.5.A.6. Claims and other notices						(4)
1.4.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	PW	E, O	M (5)	(5)
Other record documents	PDF	C	PW	E. O	M (5)	(5)
Contract closeout documents						

1. Key to Table 01 31 26-A:

a. Data Format:

- 1) EM: .msg, .htm, .txt, .rtf, e-mail text.
- 2) W: .docx, Microsoft Word 2013 or later.
- 3) EX: .xlsx, Microsoft Excel 2013 or later.
- 4) PDF: .pdf, portable document format.
- 5) DWG: .dwg, Autodesk AutoCAD 2014 drawing.

b. Transmitting User:

- 1) O: Owner.
- 2) C: Contractor.
- 3) E: Engineer.

c. Transmission Method:

- 1) EM: Via e-mail.
- 2) EMA: Attachment to e-mail transmission.
- 3) PORT: Delivered via portable media such as flash drive/thumb drive, CD, or DVD
- 4) PW: Posted to Project Website.
- 5) FTP: FTP transfer to receiving FTP server.

d. Receiving User:

- 1) O: Owner.
- 2) C: Contractor.
- 3) E: Engineer.

e. Permitted Uses:

- 1) S: Store and view only.
 - 2) R: Reproduce and distribute.
 - 3) I: Integrate (incorporate additional electronic data without modifying data received)
 - 4) M: Modify as required to fulfill obligations for the Project.
- f. Notes:
- 1) Modifications by Engineer to Contractor's Submittals and requests for interpretations are limited to printing, marking-up, and adding comment sheets.
 - 2) May be distributed only to affected Subcontractors and Suppliers. Print, sign document, and return signed paper originals to Engineer.
 - 3) Submit printed Applications for Payment with original ("wet") signatures.
 - 4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.
 - 5) Submit record drawings in native CAD format indicated when Contractor has signed Engineer's standard agreement for release of electronic media. In addition, always submit record drawings as PDF files. Comply with Contract Documents requirements for Project record documents.
 - 6) For operation and maintenance data, also submit paper copies as required by Section 01 78 23 - Operations and Maintenance Manuals.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Definition of various types of Submittals.
 2. Coordination requirements for Submittals.
 3. General provisions concerning Submittals.
 4. Schedule of Submittals.
 5. Contractor's preparation of Submittals, including:
 - a. Numbering.
 - b. Marking.
 - c. Organization and content.
 - d. Proposed "or-equals", substitutes, and deviations from Contract requirements.
 - e. Electronic Documents Submittals.
 - f. Contractor's review and approval of each Submittal.
 - g. Resubmittals.
 6. Contractor's transmittal of Submittals, including transmittal letters, transmittal and delivery method, and delivery of Samples, Closeout Submittals, and Maintenance Materials Submittals.
 7. Engineer's review, including:
 - a. Timing.
 - b. Meaning of Engineer's Submittal action code(disposition) assigned.
 - c. Delivery of Engineer's responses on Submittals.
- B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, services, incidentals, and other effort necessary to furnish Shop Drawings, product data Submittals, Samples, and other Submittals in accordance with the Contract Documents.
 2. This Section's Article, "General Provisions Concerning Submittals" includes a summary of the Contract Documents' locations of Submittals requirements.
 3. Shop Drawings, product data Submittals, Samples, and other Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Engineer's approval or acceptance, as applicable, of a Submittal does not alter or modify the Contract Documents.
 4. Engineer and Owner have the right to rely on Contractor's representations and certifications made regarding each Submittal.
- C. Related Requirements: Include but are not limited to:
1. Section 01 25 00 - Substitution Procedures.
 2. Section 01 31 26 - Electronic Communication Protocols.
 3. Section 01 29 73 - Schedule of Values.
 4. Section 01 78 23 - Operations and Maintenance Manuals.

1.2 REFERENCES

- A. References – Introduction:
1. This Article presents definitions and terminology used in this Section and throughout the Contract Documents.
 2. Applicability of the Term "Submittals": Where reference is made to Shop Drawings, product data Submittals, Samples, or other Submittals in this Section and elsewhere in the Contract Documents, the term "Submittals", as defined in the Contract Documents, is intended. The foregoing applies regardless of whether such term is indicated with an initial capital letter, unless context of the subject provision clearly indicates otherwise.

3. Types of Submittals:
 - a. Submittal types are classified as follows: (1) Action Submittals, (2) Informational Submittals, (3) Closeout Submittals, and (4) Maintenance Materials Submittals.
 - b. Type of each required Submittal is indicated in the associated Specifications section. When Submittal type is not clearly indicated in the associated Specifications section, Submittal will be classified as indicated in this Article. Submit request for interpretation when Contractor is uncertain of required Submittal type.
- B. Action Submittals:
1. Action Submittals require an explicit, written approval or other appropriate action by Engineer (or other entity to whom the Submittal is required to be furnished, in accordance with the Contract Documents) before Contractor may release the associated item(s) for raw materials procurement, fabrication, production, and shipping.
 2. Unless otherwise indicated in the Contract Documents, Action Submittals include the following:
 - a. Shop Drawings.
 - b. Product data.
 - c. Samples.
 - d. Testing plans for quality control activities required by the Contract Documents.
 - e. Delegated Designs: Delegated design professional's "instruments of service" Submittals required by the Contract Documents.
 3. General Conditions' requirements for Shop Drawings and Samples hereby apply to all Action Submittals.
- C. Informational Submittals:
1. Informational Submittals are so indicated in the Contract Documents. Unless otherwise indicated, Informational Submittals include certifications, evaluation reports, results of source quality control activities, results of field quality control activities, Supplier instructions, reports of Suppliers' visits to the Site, sustainable design Submittals (that are not Closeout Submittals), delegated design Submittals that are not "instruments of service" Submittals, qualifications statements, and others.
 2. Informational Submittals, when submitted in accordance with the Contract and indicating full compliance with the Contract Documents, do not require explicit response from Engineer (or other entity to whom the Submittal is to be delivered); Engineer's (or other entity's) acceptance thereof will be indicated in the Engineer's Submittals log. Copy of Engineer's Submittals log is available to Contractor upon Contractor's written request.
 3. When Informational Submittal does not indicate full compliance with the Contract Documents, Engineer (or other entity to which Submittal is to be delivered) will indicate the non-compliance in a written response to Contractor.
- D. Closeout Submittals:
1. Closeout Submittals are so indicated in the Contract Documents and are, in general, required before the associated Work is completed, unless earlier submittal is required by the Contract Documents.
 2. Unless indicated otherwise in the Contract Documents, Closeout Submittals include maintenance contracts, operation and maintenance data, warranties, bonds (other than performance and payment bonds required prior to the start of construction), record documents, sustainable design closeout Submittals, software, keys, and others.
 3. Closeout Submittals are processed in the same manner as described above for Informational Submittals.
- E. Maintenance Materials Submittals:
1. Maintenance materials include spare parts, extra materials, tools, and similar items required to be furnished in accordance with the Contract Documents.
 2. Furnish required physical maintenance materials, delivered to Owner or facility manager (if other than Owner), as applicable, at the location(s) indicated in the Contract Documents, for the corresponding required Maintenance Materials Submittals.

3. Maintenance Materials Submittals are documentation of delivery to Owner's or facility manager, and their acceptance of, required physical maintenance materials.
4. Maintenance Materials Submittals are processed in the same manner as described above for Informational Submittals.

F. Additional Terms:

1. The following terms have the meanings indicated below, regardless of whether such terms are indicated using initial capital letters, and apply to singular and plural of each:
 - a. "Product data" means illustrations, standard schedules, performance charts, Supplier's published instructions, brochures, diagrams, and other information furnished by Contractor to illustrate or describe materials or equipment for some portion of the Work. In general, product data are manufacturers' pre-published information on the items proposed to be incorporated into the Work. Product data includes manufacturer's catalog pages and similar documents with contractor-made markings and indications of proposed products and proposed options.
 - b. The term "Shop Drawings", defined in the General Conditions, is supplemented by the following: Shop Drawings include: (1) fabrication and assembly drawings, usually having a title block, or (2) schedules, prepared specifically for the Project. Here, "schedules" means a Project-specific summary of systems and components, such as a schedule of HVAC equipment, schedules of doors and door hardware, or windows, or a schedule of paint systems by room and surface, or other, similar Project information in a tabular format. In contrast, construction Progress Schedules, Schedules of Submittals, and Schedules of Values are not Shop Drawings.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Furnish Submittals well in advance of need for the associated material or equipment, or procedure (as applicable), in the Work and with ample time necessary for delivery of materials and equipment and to implement procedures following Engineer's approval or acceptance of the associated Submittal.
2. Work covered by a Submittal will not be included in payments by Owner until approval or acceptance (as applicable) of related Submittals has been obtained in accordance with the Contract Documents.

1.4 GENERAL PROVISIONS CONCERNING SUBMITTALS

A. Locations of Requirements:

1. Requirements concerning Submittals are generally located as follows:
 - a. General Conditions, as may be modified by the Supplementary Conditions, applicable to the Project.
 - b. This Section, which presents general requirements for Submittals applicable to the Project.
 - c. Other Division 01 Specifications that include general requirements for certain types of Submittals, such as Section 01 31 26 - Electronic Communications Protocols and Section 01 78 23 - Operation and Maintenance Data, and others.
 - d. The "Submittals" Article of the various Specifications sections, which indicates the required Submittals for the associated Work. Furnish all Submittals required by the Contract Documents regardless of whether explicitly indicated in the associated Specifications' "Submittals" Article.

- B. This Section augments and supplements the requirements of the General Conditions, as may be modified by the Supplementary Conditions, relative to Submittals.

1.5 SCHEDULE OF SUBMITTALS

A. Informational Submittals: Submit the following:

1. Schedule of Submittals:
 - a. Timing:

- 1) Furnish Schedule of Submittals within time frames indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 - 2) Submit updated Schedule of Submittals with each submittal of the updated Progress Schedule.
- b. Content: In accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent Submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all Submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Clearly indicate Submittals that are on the Project's critical path. Indicate the following for each Submittal:
- 1) Date by which Submittal will be received by Engineer.
 - 2) Whether Submittal will be for a substitution or "or-equal".
 - 3) Date by which Engineer's response is required. Allow not less than 14 days for Engineer's review, starting on Engineer's actual receipt of each Submittal. Allow increased time for large or complex Submittals.
 - 4) For Submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of others (if any).
- c. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules in Section 01 29 73 - Schedule of Values.
- d. Coordinate Schedule of Submittals with the Progress Schedule.
- e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate Submittals on the Project's critical path, or that places extraordinary demands on Engineer for time and resources, is unacceptable. Do not include Submittals not required by the Contract Documents.
- f. In preparing Schedule of Submittals:
- 1) Considering the nature and complexity of each Submittal, allow sufficient time for reviews and revisions.
 - 2) Allow reasonable time for: Engineer's review and processing of Submittals, for Submittals to be revised and resubmitted, and for returning Submittals to Contractor.
 - 3) Identify and accordingly schedule Submittals that are expected to have long anticipated review times.

1.6 PREPARATION OF SUBMITTALS

- A. Prior to Submittal Preparation:
1. The General Conditions, as may be modified by the Supplementary Conditions, address Contractor's responsibility for submitting for Owner's acceptance identification of Subcontractors and Suppliers. Obtain Owner's acceptance before entering into subcontracts and purchase orders for the Work.
 2. Comply with the Contract Documents relative to terms and conditions of subcontracts and purchase orders for the Work.
 3. Contractor's responsibilities for the following are set forth in the General Conditions, as may be modified by the Supplementary Conditions, and as may be augmented elsewhere in the Contract Documents:
 - a. Obtaining field measurements and dimensions.
 - b. Determining and verifying required quantities.
 - c. Verifying compatibility of materials.
 - d. Apportioning the Work among Subcontractors, Suppliers, and Contractor.
 - e. Reconciling required materials, equipment, and other Contract requirements with Contractor's means, methods, techniques, sequences, and procedures of construction and with Contractor's safety and protection programs and precautions incident thereto.
 - f. Reviewing applicable provisions of the Contract Documents and obtaining from Engineer necessary interpretations or clarifications.

B. Submittal Identification:

1. **Submittal Number:** Shall be a unique number assigned to each individual Submittal. Assign Submittal numbers as follows:
 - a. First part of Submittal number shall be the applicable Specifications section number, followed by a hyphen.
 - b. Second part of Submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate Submittal furnished under the associated Specifications section.
 - c. Example: Submittal number for the third Submittal furnished for Section 10 14 00 - Signage, would be “10 14 00-003”.
2. **Review Cycle Number:** Each resubmittal of a given Submittal shall be indicated with a lower-case letter designation:
 - a. No letter designation for initial (first) submittal of the Submittal number.
 - b. “a” shall indicate first resubmittal of the Submittal number.
 - c. “b” shall indicate second resubmittal of the Submittal number.
3. **Examples:**

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third Submittal furnished under Section 10 14 00 – Signage	10 14 00-003-	
Second review cycle (first resubmittal) of third Submittal furnished under Section 10 14 00 - Signage	10 14 00-003-	a

C. Marking of Submittals:

1. Mark on each page of each Submittal and each individual component submitted with Submittal number and applicable Specifications paragraph.
2. Mark each page of each Submittal with the Submittal page number.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to Engineer.
4. For product data Submittals, operation and maintenance data Submittals, and other Submittals:
 - a. Mark options to be furnished using broad, dark arrows or “clouds” clearly drawn around the relevant text or diagrams. Do not use highlighter for indicating options and features.
 - b. Indicate options and features not furnished using clear strikeouts through the text or diagrams.

D. Submittal Organization and Content – General:

1. **Page or Sheet Size;** Furnish Submittals with one or more of the following page or sheet sizes: (a) 8.5 inches by 11 inches; (b) 11 inches by 17 inches; (c) 22 inches by 34 inches; unless another sheet size is acceptable to Engineer.
2. **Language:** All parts of each Submittal shall be in the English language.
3. **Units of Measurement:** Clearly indicate units of measurement on Shop Drawings, product data Submittals, record documentation, and operation and maintenance data Submittals.
4. **Organize each Submittal logically** to facilitate ease of understanding and review.
5. To the extent practicable, arrange Submittal information in same order as requirements are written in the associated Specifications section.
6. Each Submittal shall cover Work under only one Specifications section.
7. To the extent practicable, package together Submittals for the same Specifications section. Do not furnish required information piecemeal.
8. For large or complex Submittals, include a title page and table of contents.

9. Include appropriately labeled fly sheets to separate distinct parts of each Submittal.
 10. Ensure legibility of all pages in each Submittal.
 11. Minimize extraneous and unnecessary information in Submittals for materials and equipment. Do not submit information not relevant to the Submittal and associated requirements of the Contract Documents.
 12. Contractor's, Subcontractor's, and Supplier's written comments on Shop Drawings and product data diagrams shall be colored green
 13. Do not submit under Specifications sections with title that include "Basic Requirements", unless the subject material or equipment is specified, in total, in a Specifications section with the words, "Basic Requirements" in its title.
- E. Electronic Documents Submittals:
1. Format: Electronic Documents Submittals shall be "portable document format" (.PDF) files unless expressly required otherwise by applicable provisions of the Contract Documents.
 2. Electronic Documents Submittals must be electronically searchable when delivered to Engineer and other recipients.
 3. Organization and Content:
 - a. Each Electronic Documents Submittal shall be one file; do not divide individual Submittals into multiple Electronic Documents files each unless file size will exceed 20 MB.
 - b. When Submittal is large or contains multiple parts, furnish PDF file with suitably titled electronic bookmark for each section of the Submittal.
 - c. Content shall be identical to paper or other original Submittal. First page of each Electronic Documents Submittal shall be transmittal letter required in this's Paragraph 1.7.A.
 4. Quality and Legibility: Electronic Documents Submittal files shall be made from the original and shall be clear and legible. Markings applied by Contractor, Subcontractor, or Supplier shall be clear, distinct, and readily apparent. Electronic Documents file shall be full size of original documents. Properly orient all pages for convenient reading on a computer display; do not furnish pages sideways or upside-down.
 5. Provide sufficient internet service, software, and systems for Contractor with capability appropriate for transmitting the necessary files and receiving responses from Engineer or other entities.
 6. Check not less than once per day for distribution of Electronic Documents Submittals responses and related Electronic Documents correspondence.
- F. Proposed "Or-Equals", Substitutes, and Deviations from Contract Requirements:
1. "Or-Equals":
 - a. The meaning of "or-equal" is addressed in Section 01 25 00 - Substitution Procedures.
 - b. Contractor's request for approval of "or-equals" is to be presented via the associated Action Submittal(s) and shall include the information required in provisions governing "or-equals".
 - c. Expressly and prominently indicate, "Proposed Or-Equal" on the associated Action Submittals when Submittal is for an "or-equal".
 - d. Submittals requesting approval of an "or-equal" but not accompanied by the required, supplemental information will be deemed incomplete by Engineer and returned to Contractor without approval.
 2. Substitutes:
 - a. The meaning of "substitute" is indicated in Section 01 25 00 - Substitution Procedures.
 - b. Requests for approval of substitutes shall comply with Section 01 25 00 - Substitution Procedures, and other relevant provisions of the Contract Documents.
 - c. Contractor's request for approval of substitute is separate from the associated Action Submittal(s). Action Submittals that request approval of a substitute when a separate, formal substitution request (furnished in accordance with the Contract Documents) was not previously furnished to Engineer, followed by formal approval in via an appropriate contract modification (typically either a Field Order or Change Order), will be deemed

Submittal Title: _____
Specifications: _____
Section: _____
Page No.: _____
Paragraph No.: _____
Drawing No.: [_____] of _____
Location of Work: _____ 110 River Ranch Road, Ketchum, Idaho 83340

Submittal No. and Review Cycle: _____
Coordinated by Contractor with Submittal Nos.: _____

I hereby certify that Contractor has satisfied Contractor’s obligations under the Contract Documents relative to Contractor’s review and approval of this Submittal, including: (1) reviewed and coordinated the Submittal with other Submittals and with the requirements of the Work and the Contract Documents; (2) determined and verified all: field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal, (b) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work, and (c) all information relative to Contractor’s responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; (3) confirmed the Submittal is complete with respect to all related data included in the Submittal; and (4) clearly and expressly indicated all proposed deviations (if any) from the requirements of the Contract Documents both in the Submittal itself and in the Submittal’s transmittal letter. Accordingly, this Submittal is hereby approved for Contractor by:

Approved for Contractor by: _____

H. Resubmittals:

1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding resubmitting required Submittals.
2. In addition to limits on the quantity of resubmittals, as indicated in the General Conditions, Contractor shall furnish Submittals with such completeness, accuracy, and compliance with the Contract Documents to obtain Engineer’s approval or acceptance, as applicable, without the total quantity of Submittals furnished, including all initial Submittals and all resubmittals, exceeding 150% of the number of Submittals indicated on the Schedule of Submittals initially accepted by Engineer, plus a corresponding percentage of the quantity of Submittals required by Change Orders, Work Change Directives, and Field Orders.
3. Do not increase the scope of prior review cycle of the same Submittal.
4. Indicate on Contractor’s transmittal letter how Submittal was revised from previous review cycle of the Submittal and where the revisions or corrections are located within the resubmittal.
5. Expressly address and provide response for all components previously transmitted by Engineer on prior review cycles of the subject Submittal. Where resubmittal lacks complete response to Engineer’s prior comments, Engineer may deem such resubmittal as incomplete and return it to Contractor without further review.
6. Where part of the Submittal’s prior review cycle was expressly approved or accepted, as applicable, by Engineer, do not include such items in subsequent resubmittals.
7. Indicate, “Not Yet Resolved—To Be Resubmitted at a Later Date” for any items not approved in prior review cycle of the Submittal for items not included in the subject resubmittal. Engineer reserves the right to deem incomplete Submittals “Not Approved” or “Revise and Resubmit”. Furnishing incomplete or partial resubmittals is discouraged.
8. Resubmittal of Previously Approved or Accepted Items:
 - a. Do not resubmit on a given item previously approved or accepted, as applicable, by Engineer, without Engineer’s advance consent. Consent will be given for bona-fide

unavailability of a previously approved or accepted item where Contractor has acted in good faith in a timely manner with due diligence to comply with the Contract Times.

- b. Destroy or conspicuously mark "SUPERSEDED" on all documents having previously received Engineer's approval or acceptance, as applicable, that are superseded by a resubmittal.

1.7 TRANSMITTAL OF SUBMITTALS BY CONTRACTOR

A. Contractor's Transmittal Letters for Submittals:

1. Furnish separate transmittal letter with each Submittal. Use transmittal form attached to this Section (as Exhibit 01 33 00-A) unless other transmittal form is acceptable to Engineer at the start of the Project's construction.
2. When transmittal form other than this Section's Exhibit 01 33 00-A is acceptable to Engineer, at beginning of each transmittal, include a reference heading indicating: Contractor's name, Owner's name, Project designation, Contract designation, transmittal number, and Submittal number (with review cycle).
3. "Or-Equals": When the Submittal is proposing an "or-equal", expressly so indicate on transmittal form submitted by Contractor.
4. Proposed Deviations from Contract Requirements: When the Submittal proposes deviations from requirements of the Contract Documents, transmittal letter shall specifically describe each proposed deviation:

B. Submittal Delivery Method:

1. This provision presents general requirements for delivery of all Submittals unless otherwise required elsewhere in the Contract Documents.
2. Furnish Submittals as Electronic Documents delivered in accordance with Section 01 31 26 – Electronic Communication Protocols.
3. Furnish Submittals to Engineer and each other entity indicated in the Contract Documents as receiving a Submittal directly from Contractor.
4. Address Submittals to Engineer as follows: HDR, 412 East Parkcenter Boulevard, Suite 100, Boise, Idaho 83706, to attention of Brad Bjerke, brad.bjerke@hdrinc.com.
5. Preliminary Copy for Field Office: Simultaneously with delivering Electronic Documents Submittal to Engineer, also deliver:
 - a. Electronic Documents Submittal to Resident Project Representative.
 - b. One paper copy of complete Submittal delivered to Owner's field office at the Site.

C. Samples - Transmittal and Delivery:

1. Labeling and Tagging Samples:
 - a. Securely label or tag each Sample with Submittal identification number.
 - b. Label or tag shall include clear space at least 4 inches by 4 inches in size for affixing Engineer's review stamp indicating disposition assigned by Engineer.
 - c. Label or tag shall not cover, conceal, or alter Sample's appearance or features.
 - d. Label or tag shall not be separated from the Sample.
2. Timing: Deliver required Samples concurrently with other Action Submittals required for the same element of the Work, unless other delivery time frame is indicated in the Schedule of Submittals accepted by Engineer.
3. Quantity Required:
 - a. Where the Contract Documents require a Sample as a field mock-up, provide Sample at the Site or in the Work at location acceptable to Engineer. Provide the quantity of field mock-ups required by the contract Documents; if not otherwise shown or specified, provide one of each required field mock-up. .
 - b. For reasonably portable Samples, deliver the quantity of Samples required in the associated Specifications. If quantity of Samples is not indicated in the associated Specifications section, deliver to Engineer not less than three identical Samples of each item for which Sample is required.
 - c. Samples will not be returned to Contractor. If Contractor requires Sample(s) for Contractor's use, so advise Engineer in writing and furnish additional copies of the

Sample. Contractor is responsible for furnishing, shipping, and transporting additional Samples.

4. Locations for Delivery of Reasonably Portable Samples for Review:
 - a. Deliver one physical Sample to Owner's field office at the Site.
 - b. Deliver balance of required physical Samples to Engineer at address indicated in this Article for receipt of Submittals, unless otherwise directed by Engineer.

D. Closeout Submittals –Transmittal and Delivery:

1. Furnish the following Closeout Submittals in accordance with general requirements for transmitting and delivering Submittals, indicated above in this Article: maintenance contracts; warranty bonds (when required) and other bonds required for specific materials, equipment, or systems; warranty documentation; and sustainable design closeout documentation (when required). On documents such as maintenance contracts and bonds, include on each document furnished original ("wet") signature of entity issuing said document. When original "wet" signatures are required, furnish such Submittals to Engineer both on original paper and as Electronic Documents, and to other entities furnish as indicated above in this Article for general requirements for Submittals.
2. Operations and Maintenance Manuals: Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.
3. Record Documents: Submit in accordance this Section.
4. Software: In addition to software installed on Owner's computer system, furnish number of copies of software required in the Specifications section where the software is specified. Preferred means of transmittal is via secure file transfer directly to Owner (or facility manager, if other than Owner) via secure file transfer method mutually acceptable to software developer and the receiving entity. When secure file transfer is used, submit to Engineer documentation signed or electronically acknowledged by Owner that the files were received. Where such software is available only on the software developer's portable media, furnish such software on software developer's original, portable media, sealed in software developer's original, unopened, clearly labeled packaging.

E. Maintenance Materials Submittals – Delivery:

1. Deliver physical maintenance materials required by the Contract Documents in accordance with applicable provisions of the Contract.
2. Submit documentation of delivery of (Maintenance Materials Submittals) in accordance with general requirements for Submittals as indicated in this Section.

1.8 ENGINEER'S REVIEW OF SUBMITTALS

A. This Article applies to review of all Submittals by Engineer or other entity to whom the Contract Documents require such Submittal be furnished.

B. Timing:

1. Timing of Engineer's review will be in accordance with the Schedule of Submittals accepted by Engineer.
2. When Submittal is delivered to Engineer on a date other than that indicated in the Schedule of Submittals accepted by Engineer, duration of Engineer's review may differ from that indicated in the Schedule of Submittals, based on Engineer's availability and resources. Engineer will make good-faith effort to furnish responses to Submittals in a timely manner.
3. Contractor is responsible for communicating to Engineer when a Submittal is on the Project's critical path.

C. Engineer's Review:

1. Markings:
 - a. Comments or responses marked directly on Submittal by Engineer (or other entity reviewing Submittal) will be colored red.
 - b. Engineer may also present narrative comments on a comment sheet inserted by Engineer into the Submittal or included on Engineer's transmittal letter for the

Submittal. Such comments will be in black text. When a separate comment sheet is included by Engineer, such sheet will be clearly identified as Engineer's comments.

2. Engineer's review and disposition assigned to Submittal are subject to the following:
 - a. Submittal disposition is subject to: Engineer's comments on the Submittal; disclaimer language on Engineer's Submittal transmittal letter; Engineer's Submittal review stamp (when used) or equivalent (when used); and this provision.
 - b. Engineer's review is only for general compatibility with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents, and for general compliance with the information given in the Contract Documents.
 - c. Contractor shall be solely responsible for complying with the Contract Documents, as well as with Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations. Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.
 - d. Engineer is not responsible for resubmittals not yet furnished by Contractor or tracking Contractor's progress on resubmittals.
3. Documents not required by the Contract Documents but nonetheless furnished by Contractor as submittals will not be reviewed by Engineer.

D. Meaning of Submittal disposition Assigned by Engineer:

1. Action Submittals:
 - a. "Approved" (Action Code A): Upon return of Submittal marked "Approved", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of production-related qualifications statements and certifications, and required source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents.
 - b. "Approved as Noted" (Action Code B): Upon return of Submittal marked "Approved as Noted", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of production-related qualifications statements and certifications, and required source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents, and in accordance with Engineer's comments and notes indicated in Engineer's Submittal response
 - c. "Revise and Resubmit" (Action Code C): Upon return of Submittal marked "Revise and Resubmit", make the revisions necessary and indicated and resubmit to Engineer for approval.
 - d. "Not Approved" (Action Code D): This disposition indicates material or equipment that cannot be approved. "Not Approved" disposition may also be applied to Submittals that are incomplete. Upon return of Submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment, with a complete Submittal clearly indicating all information required.
2. Informational, Closeout, and Maintenance Materials Submittals:
 - a. "Accepted" (Action Code F): Information included in Submittal complies with the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to such Submittal, and the Work covered by the Submittal may proceed. Materials and equipment with Submittals with this disposition may be shipped or operated, as applicable. Submittals assigned "Accepted" by Engineer (or other reviewing entity) does not indicate Engineer's acceptance of the associated Work, which is indicated only as set forth in the General Conditions and Section 01 77 19 – Closeout Requirements.
 - b. "Not Acceptable" (Action Code G): Submittal, or part thereof, does not indicate full compliance with applicable requirements of the Contract Documents and is not

acceptable. Provide labor, materials, equipment, services, and incidentals necessary to properly and accurately revise Submittal and resubmit to indicate acceptability and compliance with the Contract Documents

3. Other:
 - a. "Submittal Not Reviewed" (Action Code E): Documents so marked by Engineer are not required by the Contract Documents. Submittals may also be marked with this disposition when information in the document was previously reviewed and approved or accepted by Engineer, as applicable.
- E. Distribution of Engineer's Responses:
 1. Unless otherwise indicated in the Contract Documents, Engineer will distribute written responses (as Electronic Documents) to Submittals to the following:
 - a. Contractor.
 - b. Owner.
 - c. Engineer's file.
 2. Engineer's acceptance of Informational Submittals, Closeout Submittals, and Maintenance Materials Submittals will be recorded in Engineer's Submittal log. Copy of Engineer's Submittals log is available from Engineer upon written request of Owner or Contractor. If no such request is received by Engineer, Engineer will distribute copy of Engineer's Submittals log once per month (when Submittals have been received or acted on by Engineer). Engineer may distribute copy of Engineer's Submittals log as an Electronic Document or as handout at construction progress meetings.
 3. Paper copies of Engineer's Submittal responses will not be distributed unless otherwise required by the Contract Documents or otherwise agreed to by Engineer.
 4. Contractor is responsible for forwarding Engineer's Submittals responses to Subcontractors and Suppliers as appropriate, and for coordinating the Work of all trades.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The documents listed below, following this Section's "End of Section" designation, are part of this Specifications Section:
 1. "Exhibit 01 33 00-A – Transmittal for Submittal No. [_____]" (one page).

END OF SECTION

**Transmittal for Submittal
No. []-[]**

Project Name: Ketchum / SVWSD WRF – Aeration Upgrades					Date Received:	
Project Owner: City of Ketchum and Sun Valley Water and Sewer District					Checked By:	
Contractor:			HDR Engineering, Inc.		Log Page:	
Address:			Address:		HDR No.:	
					Spec Section:	
					Drawing/Detail No.:	
Attn (Contractor):			Attn (HDR):		Review Cycle	
Date Transmitted by Contractor:			Date of Engineer's Response Transmittal:			
Item No.	Submittal No.	Description (indicate number of copies where paper copies of physical Samples are returned)	Manufacturer	Supplier Dwg or Data No.	Engineer's Disposition (Action Code) *	
1						
2						
3						
4						
Contractor's Remarks (insert text):						
Engineer's Remarks (insert text) :						
* Legend for Action Code indicated above, assigned by Engineer:						
Action Submittal: A – Approved B – Approved as Noted C – Revise and Resubmit D – Not Approved			E – Submittal Not Reviewed Informational, Closeout, or Maintenance Materials Submittal: F – Accepted (this code normally recorded in Engineer's Submittals log). G – Not Acceptable			
Engineer's Disclaimer (for Submittals that do <u>not</u> involve delegated design):						
a. Submittal action code is subject to: Engineer's comments on the Submittal, comment sheets (if any), and this transmittal letter; disclaimer language on Engineer's Submittal review stamp or equivalent; and Specifications Section 01 33 00 – Submittal Procedures.						
b. Engineer's review is only for general compatibility with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents, and for general compliance with the information given in the Contract Documents.						
c. Contractor shall be solely responsible for complying with the Contract Documents, as well as with Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations. Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.						
Reviewed for HDR by:					Date of Engineer's Review:	
Distribution:		Contractor	File	Field	Owner	Other

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SECTION 01 35 43.13
ENVIRONMENTAL PROCEDURES FOR HAZARDOUS MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General responsibilities and enforcement concerning Constituents of Concern at the Site.
 2. Notifying Owner of Constituents of Concern at the Site.
 3. Hazard communication plan.
 4. Emergency/spill response plan.
 5. Storage of materials containing Constituents of Concern and storage of non-hazardous materials.
 6. Area for storing materials containing Constituent(s) of Concern.
 7. Verification of compliance.
- B. Scope:
1. Contractor's responsibilities for remediating a known Hazardous Environmental Condition, if any, at the Site are set forth in the Specifications of Division 02 – Existing Conditions.
 2. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required to comply with requirements of this Section and related provisions of the General Conditions, as may be modified by the Supplementary Conditions.
 3. In this Section's title, "hazardous materials" means "Constituents of Concern" as defined in the General Conditions.

1.2 BASIC RESPONSIBILITIES AND ENFORCEMENT REGARDING CONSTITUENTS OF CONCERN AT THE SITE

- A. Scope – Basic Responsibilities:
1. Contractor shall develop, implement, and maintain throughout the Project a hazardous materials management program (HMMP) in accordance with Laws and Regulations and the Contract Documents.
 2. Constituents of Concern Brought to Site by Contractor:
 - a. Transport, handle, store, label, use, and dispose of materials containing Constituents of Concern in accordance with this Section, other applicable provisions of the Contract Documents, and Laws and Regulations.
 3. Constituents of Concern Generated by Contractor:
 - a. Materials containing Constituents of Concern shall be properly handled, stored, labeled, transported and disposed of by Contractor in accordance with Laws and Regulations, and this Section.
 - b. If Contractor will generate or has generated materials containing Constituents of Concern at the Site or adjacent areas, obtain a USEPA identification number listing Contractor's name and address of the Site as generator of the Constituents of Concern. Obtain identification number from state environmental agency or other authority having jurisdiction at the Site. Submit identification number within time limit indicated in this Section's "Submittals" Article.
 - c. Contractor is responsible for identifying, analyzing, characterizing, labeling, storing, transporting, and disposing of Constituents of Concern generated by Contractor.
 4. Cost Responsibility:
 - a. Fines and civil penalties imposed on Owner or facility manager (if other than Owner) for Contractor's violations, whether at the Site or other locations, and other costs incurred by Owner and facility manager associated with cleanup of a Hazardous Environmental Condition created or exacerbated by Contractor shall be paid by Contractor.

- b. If Contractor has exacerbated a Hazardous Environmental Condition existing at the Site prior to the start of the Work, Contractor shall pay Contractor's appropriate share of costs associated with fines, civil penalties, and cleanup costs in proportion equal to the extent of costs for which Contractor caused or exacerbated the Hazardous Environmental Condition and fines and civil penalties associated therewith.
 - c. If Contractor fails or refuses to pay such costs, Owner may pay the costs and deduct from payments due Contractor a reasonable set-off.
- B. Owner's Environmental Representative:
- 1. Owner's environmental representative is: Mick Mummert, Wastewater Superintendent.
- C. Enforcement of Laws and Regulations Regarding Constituents of Concern and Hazardous Environmental Conditions:
- 1. To extent practicable, avoid creating or exacerbating situations causing or contributing to injury to persons, spills and emissions of Constituents of Concern, contamination of the Site and other areas, and damage (to property and the environment) caused by Hazardous Environmental Conditions.
 - 2. When Owner or facility manager (if other than Owner) is aware of or suspects violations may have occurred or may occur, Owner or facility manager will notify Contractor, and authorities having jurisdiction, when Owner or facility manager reasonably believes doing so is necessary or appropriate. However, no such right of Owner, facility manager, or any entity for whom Owner or facility manager is responsible, including Engineer (or its consultants and subcontractors), is for benefit of Contractor. Owner, facility manager, and any entity for whom Owner or facility manager is responsible, including Engineer, are not obligated to monitor presence of, use of, storage or handling of, Constituents of Concern at the Site or other areas, or present of a potential Hazardous Environmental Condition or to act on behalf of Contractor or anyone for whom Contractor is responsible.
 - 3. Responsibilities regarding Laws and Regulations shall be in accordance with the General Conditions, as may be modified by the Supplementary Conditions.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following to the entity(ies) indicated for each:
- 1. Indication of Constituents of Concern (including Chemicals) Proposed for Use at the Site:
 - a. Submit to Owner's environmental representative; do not submit to Engineer. Engineer will not accept, review, or retain such information or Submittals in Engineer's files.
 - b. Submit the information required in sufficient time for Owner's review and acceptance not later than three days before bringing associated Constituent of Concern to the Site.
 - c. Submittal Content:
 - 1) Current (dated within the past two years) safety data sheets (SDS, formerly "material safety data sheets") in accordance with 29 CFR 1910.1200 (OSHA Hazard Communication Standard).
 - 2) Manufacturer of material or equipment containing such substance.
 - 3) Supplier (if other than manufacturer).
 - 4) Container sizes and number of containers proposed to be at the Site.
 - 5) Minimum and maximum volume of material intended to be stored at the Site.
 - 6) Description of process or procedures in which Constituent(s) of Concern will be used at the Site.
 - 2. Material Containing Constituents of Concern Generated at the Site:
 - a. Submit to Owner's environmental representative; do not submit to Engineer. Engineer will not accept, review, or retain such information or Submittals in Engineer's files.
 - b. Submit the information required prior to generating each associated Constituent of Concern at the Site or adjacent areas. Submit within not less than 48 hours after Contractor's receipt of associated analytical results.
 - c. Submittal Content:
 - 1) For each Constituent of Concern generated at the Site or adjacent areas:
 - a) USEPA identification number.

- b) Laboratory analysis results.
 - c) Quantity, size, and location of storage containers at the Site or adjacent areas.
- 3. Permits:
 - a. Submit to Owner's environmental representative; do not submit to Engineer. Engineer will not accept, review, or retain such information or Submittals in Engineer's files.
 - b. Submit within 48 hours of obtaining each associated permit.
 - c. Submittal Content:
 - 1) Copies of each permit obtained for storing, handling, using, transporting, and disposing of materials containing Constituents of Concern, obtained from authorities having jurisdiction.
- 4. Other Documents Required for the HMMP:
 - a. Submit to Owner's environmental representative; do not submit to Engineer. Engineer will not accept, review, or retain such information or Submittals in Engineer's files.
 - b. Submit requested documents within 72 hours of Contractor's receipt of such request.
 - c. Submittal Content:
 - 1) Submit requested HMMP documents, which may include emergency/spill response plan, communication plan, and other documents.

1.4 HAZARDOUS MATERIALS MANAGEMENT

- A. Obtain Owner's environmental representative's acceptance before bringing to the Site each material containing a Constituent of Concern.
- B. Hazard Communication Plan:
 - 1. Develop and implement a communication plan relative to materials containing one or more Constituents of Concern.
 - 2. Safety Data Sheet (SDS) Notebooks:
 - a. Maintain at the Site not less than two notebooks containing:
 - 1) Inventory of materials containing a Constituent of Concern (including all chemicals).
 - 2) Current (dated within the past two years) SDS for all materials being used to accomplish the Work, whether or not defined as a Constituent of Concern.
 - b. Keep one notebook in Contractor's field office at the Site; keep second notebook at location acceptable to Owner's environmental representative.
 - c. Keep notebooks up-to-date as materials are brought to and removed from the Site.
- C. Emergency/Spill Response Plans:
 - 1. Develop, implement, and maintain an emergency/spill response plan, for each Constituent of Concern or each class or group of material containing a Constituent(s) of Concern, as applicable.
 - 2. Response plan shall include not less than the following:
 - a. Description of materials and equipment available at the Site to contain or respond to emergencies related to or spills of the materials containing one or more Constituents of Concern.
 - b. Procedures for notifying, and contact information for:
 - 1) Authorities having jurisdiction.
 - 2) Emergency responders.
 - 3) Owner.
 - 4) Engineer.
 - 5) Owner's Site Representative (OSR).
 - 6) The public, as applicable.
 - 7) Other entities as necessary or required.
 - c. Response coordination procedures between Contractor, Owner or facility manager (if other than Owner), and others as appropriate.
 - d. Site plan showing proposed locations of Constituents of Concern storage areas and location of spill containment/response materials and equipment, and location of storm

water drainage inlets, catch basins, and drainage routes, including storm sewers, ditches and swales, and surface waters.

- e. Description of Constituent of Concern handling and emergency/spill response training provided to Contractor's and Subcontractors' workers, in accordance with 29 CFR 1926.21(b) ("Employer Responsibility") and other Laws and Regulations.
- D. Storage of Materials Containing Constituents of Concern and Storage of Non-Hazardous Materials:
1. Vessels containing materials with a Constituent of Concern shall bear applicable, clearly visible NFPA hazard diamonds.
 2. Container Labeling:
 - a. Properly label each container of combustible materials, whether or not classified as containing a Constituent of Concern.
 - b. Stencil Contractor's name and, as applicable, Subcontractor's name, on:
 - 1) Each vessel containing a Constituent of Concern; and
 - 2) For non-hazardous materials, on each container over five-gallon capacity.
 - c. Each container shall have securely-attached label clearly identifying contents. Also label containers that are filled from larger containers.
 - d. If Owner or facility manager (if other than Owner) becomes aware of unlabeled containers at the Site, Owner's environmental representative will so advise Contractor, although Owner's and facility manager's personnel are not obligated to do so. Properly label each containers within one hour of receipt of such notice from Owner or facility manager, or remove container from the Site and adjacent areas.
 - e. Properly dispose of materials containing Constituents of Concern, in accordance with Laws and Regulations, at a location other than the Site and adjacent areas.
 3. To greatest extent possible, store at offsite location materials containing a Constituent of Concern until required for use in the Work.
- E. Area for Storing Materials Containing Constituent(s) of Concern:
1. Maintain designated storage area for materials containing one or more Constituents of Concern. Storage area shall include secondary containment to prevent release of spilled or leaking substances. Storage area shall include barriers to prevent vehicles from colliding with storage containers, and shall include protection from environmental effects such as elements, temperature, sunlight, and other environmental effects.
 2. Provide signage in accordance with Laws and Regulations, clearly identifying the storage area.
- F. Verification of Compliance:
1. Not less than monthly, Contractor's safety representative shall meet with Owner's environmental representative at the Site to:
 - a. Review Contractor's HMMP documents.
 - b. Review HMMP procedures.
 - c. Inspect storage areas and the Site in general, to verify compliance with this Section.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 35 73
DELEGATED DESIGN PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General provisions for delegated design services.
 2. Coordination of delegated designs with other Work.
 3. Qualifications requirements for delegated design professionals.
 4. Limitations on Engineer's review of delegated design Submittals.
 5. Responsibilities of delegated design professionals.
- B. Scope:
1. Where delegated design is specifically Contractor's responsibility in accordance with the Contract Documents, Contractor shall provide labor, services, other effort, and pay all costs necessary and required to perform delegated design services for Work that will be part of the completed Project as a functioning whole.
 2. Perform delegated design Work in accordance with the Contract Documents, delegated design Action Submittals approved by Engineer, and Shop Drawings, product data Submittals, and Samples approved by the associated delegated design professional.
 3. Contractor's correction period, general warranty and guarantee, and obligations for safety and protection apply to delegated design Work to the same extent such provisions apply to all other Work under the Contract.
 4. Specifications requiring delegated design services include, but are not necessarily limited to, the following:
 - a. Section 03 41 33 - Precast and Prestressed Concrete.
 - b. Section 05 40 00 - Cold-Formed Metal Framing.
 - c. Section 05 50 00 - Metal Fabrications.
 - d. Section 40 05 07 - Pipe Support Systems.
 5. Not Delegated Design: The following are not delegated design and are not covered by this Section:
 - a. Contractor's use of design professionals for: (1) temporary construction or temporary facilities not part of the completed Project as a functioning whole, or (2) Contractor's means, methods, procedures, techniques, and sequences of construction and safety and protection measures incident thereto.
 - b. Certain final designs that, in accordance with commonly accepted practice, are typically prepared by unlicensed, unregistered individuals, including for manufactured or fabricated systems, components or assemblies, not acting under the supervisory control of the design professional in responsible charge, but who commonly possess appropriate certification from a relevant industry organization, together with appropriate training and experience.
- C. Related Requirements:
1. Sections of Divisions 02-49 where delegated design Work is required.

1.2 REFERENCES

- A. Terminology:
1. Terminology indicated below are not defined terms and are not indicated with initial capital letters but, when used in this Section and Specifications of Division 02-49 where delegated design Work is required, have the meaning indicated below:
 - a. "Delegated design" means preparing the final design of part of the completed, permanent Work by one or more delegated design professionals, in accordance with the Contract Documents. The terms "delegated design", "delegated design services",

“delegation of design responsibility”, and similar or derivative terms have the same meaning.

- b. “Delegated design professional” means the licensed and registered engineer, architect, geologist, or other design professional retained by or employed by Contractor, Subcontractor, or Supplier to perform delegated design services for delegated design Work and possessing appropriate experience and qualifications for such delegated design services.
- c. “Delegated design Work” means delegated design services, associated construction, and related Work.
- d. “Instruments of service”, relative to delegated designs, means delegated design professional’s: (1) certifications (including delegated design professional’s certification of compliance, as required in this Section, and other certifications required of delegated design professional), (2) reports (where required), (3) design drawings, (4) design specifications, (5) other documents specifically indicated as delegated design professional’s “instruments of service” in the Contract Documents, and (6) documents modifying a delegated design (after Engineer’s approval of the original delegated design Submittals). “Instruments of service” are to be sealed, signed, and dated by delegated design professional and expressly required as Submittals. Shop Drawings sealed and signed by delegated design professional are delegated design professional’s “instruments of service”.

1.3 GENERAL PROVISIONS CONCERNING DELEGATED DESIGN SERVICES

A. Delegated Designs - General:

- 1. This Section augments the requirements of the General Conditions, as may be amended by the Supplementary Conditions, and other provisions of the Contract Documents regarding Contractor’s responsibilities for delegated design Work.
- 2. Delegated design professionals or their employer shall furnish professional liability insurance. Provisions on professional liability insurance are set forth in the Supplementary Conditions. Submit through Contractor appropriate documentation of professional liability insurance.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Coordination - General:
 - a. Contractor shall coordinate the services of delegated design professionals with all other elements of the Work.
 - b. Contractor has full responsibility for scheduling delegated designs and all related Work.
 - c. Allow sufficient time in Progress Schedule for performance of delegated design services, including requests for interpretation or clarification between delegated design professional and Contractor and between Contractor and Engineer.
- 2. Coordination of Delegated Design Work’s Connections to Other Work:
 - a. Where delegated design Work connects to other Work designed by Engineer, existing construction, or both, the delegated design Work shall be consistent with the other Work and existing construction to which delegated design Work connects, and adjacent construction.
 - b. Submit details, loading, anchorage, and other coordinating information necessary for the delegated design Work to properly interface with Work designed by Engineer.
 - c. Changes in the Work, whether designed by Engineer, designed by delegated design professional, or existing construction, necessary as a result of the delegated design are ineligible for increase in Contract Price or Contract Times, unless: (1) otherwise agreed by both Engineer and Owner, or (2) expressly indicated otherwise elsewhere in the Contract Documents for the associated delegated design Work.
 - d. Changes requiring extra compensation, time, or both arising from delegated design aspects needed for convenience of Contractor, Subcontractor, or Supplier, are not grounds for increase in Contract Price or Contract Times.

3. Coordination of Submittals, Fabrication, Production, and Shipment:
 - a. Do not release for raw materials procurement, fabrication, production, and shipment to the Site materials, equipment, or systems designed by delegated design professional until the associated delegated design professional has reviewed and approved all associated Shop Drawings, product data, Samples, and (relative to shipment) source quality control Submittals, and such Submittals have been delivered to and accepted by Engineer.
 - 1) For delegated design systems that required reactions to be submitted to the Engineer. These submittals shall be submitted and approved first before approval is given for the delegated design submittal.
 - b. Allow sufficient time in the Progress Schedule for required Submittals and required actions by delegated design professionals and Engineer.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Delegated Design Professionals:
 - a. Each delegated design professional shall possess not less than the minimum qualifications set forth in this provision. Where the Specifications for the associated delegated design Work establish more-stringent qualifications requirements, comply with the more-stringent requirements.
 - b. Each delegated design professional shall comply with all of the following:
 - 1) Legally qualified, as both an individual and as a business entity, to practice the associated design discipline(s) in the jurisdiction where the Site is located, including possessing current, valid license and registration for the design discipline(s) for which the delegated design professional will render its services on the Project.
 - 2) Possess not less than five years of experience in the subject design discipline(s).
 - 3) Served as design professional in responsible charge on not less than five other designs similar in scope and complexity to the Work for which delegated design professional is retained on the Project; construction of such prior projects shall be complete by the start of the Project's construction.
 - c. Summary of Qualifications: Submit to Engineer summary of delegated design professional's experience and qualifications, including:
 - 1) Evidence of coverage under appropriate professional liability insurance in accordance with the Contract Documents.
 - 2) Evidence of delegated design professional's ability to legally conduct business as a design professional in the same jurisdiction as the Site, as a business entity.
 - 3) Copy of delegated design professional's current, valid personal design professional license and registration for the same jurisdiction as the Site. Such documents shall indicate the individual's name, license or registration number, and dates for which the license or registration is valid.
 - 4) Other information reasonably requested by Engineer.

1.6 GENERAL PROVISIONS FOR DELEGATED DESIGN SUBMITTALS

- A. Under the Division 02-49 Specifications section(s) where delegated design Work is required, furnish to Engineer Submittals such as:
 1. Action Submittals:
 - a. Delegated design professional's instruments of service Submittals.
 2. Informational Submittals:
 - a. When delivered to Engineer, the following must bear delegated design professional's Submittal approval stamp:
 - 1) Shop Drawings, product data Submittals, Samples, testing plans.
 - 2) Results of source quality control and field quality control activities.
 - b. Delegated design professional's calculations.
 - c. Other Informational Submittals required for the subject delegated design Work.

- B. Limitations of Engineer's Review of Delegated Design Submittals:
1. Delegated Design Professional's Instruments of Service Submittals:
 - a. Engineer's review of delegated design instruments of service Submittals is for the limited purposes indicated in this Section's "General Provisions Concerning Delegated Designs" Article.
 - b. The following disclaimer applies to Engineer's responses to delegated design professional's instruments of service Submittals:
 - 1) Engineer's review and approval of delegated design instruments of service is only for the limited purpose of verifying that performance and design criteria given in the Contract were used in the delegated design, and checking for compliance with the Engineer's design concept expressed in the Contract Documents.
 - 2) Contractor is solely responsible for complying with: the Contract Documents, Subcontractor and Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations.
 - 3) Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the Work of all trades.
 - 4) Engineer is not responsible for the effects of resubmittals or tracking progress of resubmittals.
 2. Delegated Design Informational Submittals:
 - a. Other provisions of the Contract Documents notwithstanding, Engineer's review of delegated design Informational Submittals is limited to only:
 - 1) Verifying the Submittal was furnished as required; and
 - 2) Submittal generally appears complete (except for calculations); and
 - 3) Submittal bears delegated design professional's approval stamp; or, for calculations prepared by or for delegated design professional, that such calculations bear delegated design professional's seal, signature, and date; or, for delegated design professional's reports of visits to the Site, that such report is legible, and bears delegated design professional's signature with date.
 - b. Engineer receives such Submittals, including delegated design professional's calculations, on behalf of Owner, for Owner's records.
 - c. Engineer, Owner, and others involved in the Project have the right to rely on delegated design professional's approval stamp as meaning that the delegated design professional has performed and appropriate review of the Submittal and determined it to be complete, in accordance with delegated design professional's instruments of service approved by Engineer, in accordance with delegated design professional's design intent, and in accordance with the Contract Documents.
 3. Engineer's Other Comments on Delegated Design Submittals:
 - a. Despite the limitations of Engineer's review of Submittals for delegated design Work, should Engineer become aware of, or reasonably suspect existence of, potential of associated delegated design Work to adversely affect health, safety, or welfare of persons, or pose reasonable potential for damage to the Work, work of other contractors, or adjacent property, Engineer will advise Contractor in writing of general nature of Engineer's concern.
 - b. Such advisory by Engineer, if issued, is rendered in good faith and does not in any way constitute:
 - 1) Engineer's review of all aspects of the delegated design.
 - 2) Any sharing by Engineer of any of delegated design professional's responsibilities or professional liability.
 - 3) Any responsibility imposed, in any way, on Engineer for any aspect of the delegated design professional's services or design, beyond the limited purposes of Engineer's review as set forth in the Contract Documents. .

- c. Contractor and its Subcontractors and Suppliers, including delegated design professionals, shall immediately investigate Engineer's concern indicated in such advisory and remedy as necessary and required.
- d. Neither Engineer nor Owner, nor their respective consultants and subcontractors, is obligated to review any Submittal for delegated design Work beyond the limited review required by the Contract Documents. No such advisory, if issued, entitles Contractor, Subcontractor, or Supplier, including delegated design professionals, to rely on such advisory or to assume that any further such reviews or written or oral advisories are forthcoming.

1.7 RESPONSIBILITIES OF DELEGATED DESIGN PROFESSIONALS

A. Standard of Care:

- 1. Unless a higher standard of care is established by the Division 02-49 Specifications section where the associated delegated design Work is required, the delegated design services shall comply with the following standard of care:
 - a. Except as provided in the paragraph immediately above this, the standard of care for all delegated design professional services and related services performed or furnished by delegated design professionals for the Project will be the care and skill ordinarily used by members of the subject profession practicing under similar circumstances at the same time and in the same locality.

B. Responsibilities of delegated design professionals employed on the Work include, but are not necessarily limited to, the following, unless specifically indicated otherwise in the associated elements of the Contract Documents where the delegated design is required:

- 1. **Ethical Conduct and Professionalism:** Comply with Laws and Regulations and applicable standards and guidelines relevant design professional organizations for ethical conduct and professional practice.
- 2. Comply with Laws and Regulations and relevant design standards applicable to the subject delegated design Work.
- 3. **Performance and Design Criteria Indicated in the Contract Documents and Other Information:**
 - a. Review performance and design criteria, indicated in the Contract Documents, that the delegated design Work must satisfy.
 - b. Prepare written requests for interpretations or clarifications of performance or design criteria.
 - c. Review existing information about the Site that constitutes Technical Data (if any, applicable to the subject delegated design Work), as indicated in the Supplementary Conditions.
- 4. **Site Information and Investigations:** With Contractor, obtaining all other necessary dimensions, field information, and other information necessary for preparing delegated design Submittals.
- 5. **Design and Other Professional Services:** Personally perform and prepare, or actively exercise direct, personal, supervisory control over others performing or preparing:
 - a. Necessary design professional evaluations of conditions, materials, and equipment.
 - b. Prepare the instruments of service Submittals and calculations Submittal for the subject delegated design Work, where required by the associated Division 02-49 Specifications and other, associated Contract Documents.
 - c. Assist Contractor with applying for and obtaining permits and approvals (not previously obtained by Owner or those for whom Owner is responsible) necessary for the delegated design Work.
 - d. Review and approve or take other appropriate action on Shop Drawings (unless such Shop Drawings are sealed and signed by delegated design professional), product data, Samples, and testing plans, and other Submittals associated with the delegated design Work.
 - e. Prepare modifications of the delegated design instruments of service as necessary.

6. Sealing and Signing:
 - a. Seal, sign, and indicate date of sealing and signing, on all of the following when such Submittals are required by the Division 02-49 Specifications where the delegated design Work is required:
 - 1) Instruments of service Submittals, including certification of compliance required.
 - 2) Calculations.
 - 3) Modifications to the delegated design.
 - 4) Other documents required to be sealed and signed by Laws or Regulations or the Contract Documents.
 - b. Sealing and signing documents in accordance with Laws and Regulations and the Contract Documents, prior to submittal (through Contractor) to Engineer, and for submittal to authorities having jurisdiction to obtain necessary permits and approvals.
 - c. Sealing and signing shall be in accordance with Laws and Regulations.
7. Certification of Compliance by Delegated Design Professional:
 - a. Schedule:
 - 1) Submit certification of compliance after Engineer's acceptance of delegated design professional's qualifications statement.
 - 2) Obtain Engineer's approval of certificate of compliance Submittal prior to furnishing other Submittals for delegated design Work under the same Specifications section, unless otherwise allowed by Engineer.
 - b. Through Contractor, submit to Engineer, delegated design professional's written certification indicating:
 - 1) General Information: (1) Project name and designation, (2) Contractor name and Contract designation, (3) Subcontractor or Supplier name (when applicable), (4) full name of delegated design professional's business entity under which the delegated design services were performed, (5) full name and license number of the individual sealing and signing the subject delegated design Work, (6) specific elements of delegated design Work to which the certification applies, and (7) delegated design professional's seal, signature, and date of signature.
 - c. Explicit certification that the subject delegated design complies with:
 - 1) All applicable performance and design criteria indicated in the Contract Documents. Expressly indicate on certification of compliance the specific performance and design criteria used in the delegated design, and reaction forces of the delegated design imparted to other Work and existing construction. Reaction forces imparted from the delegated design elements to the Engineer's designed system shall include the following:
 - a) Reaction forces imparted from the delegated design elements to the Engineer's designed system shall be presented as follows:
 - (1) Unfactored loads per category (dead, live, wind, seismic, etc.).
 - (2) Load combinations presented in Load Factor Resistance Design (LRFD) format from each element transmitting load.
 - b) All Laws and Regulations.
 - c) Applicable design standards commonly applicable to such types of construction. Expressly indicate such design standards on the certification of compliance.
 - d) The applicable standard of care. Expressly indicate the applicable standard of care.
8. Approvals of Other Delegated Design Submittals:
 - a. Review and taking appropriate action on Submittals for delegated designs:
 - b. Such reviews and approvals or other appropriate action shall be to ascertain compliance with:
 - 1) Delegated design professional's design intent.
 - 2) Delegated design professional's instruments of service and calculations.
 - 3) Associated requirements of the Contract Documents.

- c. Delegated design professional's review stamp or facsimile thereof, review action or disposition concerning the associated Submittal for the delegated design, date of review, and name of person performing the review shall be clearly legible on the associated Submittals (except for delegated design professional's own instruments of service Submittals, calculations, and reports of delegated design professional's visits to the Site). Prominently display delegated design professional's Submittal review stamp or facsimile thereof on: (1) each sheet of Shop Drawings, (2) each major section of product data Submittals, (3) each Sample, (4) each testing plan, and (5) each other Submittal associated with the delegated design for which such review stamp is required.
 - d. Do not apply delegated design professional's Submittal review stamp and comments, if any, over other text, tables, or graphics.
 - e. Where review stamp or facsimile thereof is required, submit to Engineer only those Submittals for delegated design Work that bear delegated design professional's explicit approval of the Submittal.
9. Respond promptly to requests for interpretation or clarification on delegated design professional's instruments of service and other Submittals for the delegated design Work.
10. Progress and Quality of Construction of Delegated Design Work:
- a. Where appropriate for the subject delegated design Work, periodically visit the Site at appropriate intervals to observe the progress and quality of the subject delegated design Work.
 - b. Where delegated design professional does not visit the Site during construction, keep informed of the progress and quality of the subject delegated design Work via discussions with Contractor, Subcontractor, and Suppliers, via photographic documentation, and other means acceptable to delegated design professional.
 - c. Advise Contractor in writing when the subject delegated design Work is not in accordance with the delegated design professional's instruments of service (approved by Engineer) and related Submittals approved by delegated design professional.
 - d. Furnish to entity that retained delegated design professional copy of delegated design professional's written report of each visit to the Site.
11. Modifications to Design:
- a. Design appropriate modifications to the delegated design Work, including preparing new or revised certifications, reports, design drawings, sketches, design specifications, and calculations, as appropriate.
 - b. Such instruments of service and calculations shall be submitted to Engineer through Contractor to same extent original instruments of service Submittals and calculations, if any, where required by the Contract Documents for the subject delegated design Work.
12. Other services, as mutually agreed upon by delegated design professional and its client, or as required elsewhere in the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 41 24
PERMIT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements relative to permitting of which Owner and Engineer are aware that apply to the Work.
 - 2. Required municipal permits and licenses of which Owner and Engineer are aware.

- B. Scope:
 - 1. Contractor shall provide labor, materials, equipment, tools, and incidentals shown, specified, and required to obtain required permits and comply with required permits and licenses.
 - 2. Obtain and comply with required permits and licenses whether or not indicated in this Specifications section or elsewhere in the Contract Documents. Owner will pay permit fees associated with local building requirements.

- C. Related Requirements:
 - 1. In addition to permits and licenses required under this Specifications section, obtain and comply with permits required under the following Specifications:
 - a. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compliance with permit and license requirements with Work under other Specifications sections and with other contractors, if any, working at the Site.
 - 2. Coordinate with the Progress Schedule the time required to apply for and obtain required permits and licenses and to comply with requirements thereof. Changes in Contract Times or Contract Price will not be authorized because of timing and costs associated with obtaining permits and licenses required for the Work.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Copy of each of the following permits, as applicable to the Work:
 - a. Blower Building Addition:
 - 1) Building Permit.

1.4 MUNICIPAL PERMITS AND LICENSES

- A. Permits:
 - 1. Blower Building Addition:
 - a. Building Permit.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 42 00 REFERENCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Defined terms and terminology.
 2. Construction Codes: Indication of applicable building code and other construction codes.
 3. Referenced Standard Specifications and Construction Guidelines: Indication of Owner's or third-party specifications and construction standards applicable to one or more parts of the Work.
 4. Abbreviations in general use in the Contract Documents.
 5. Reference Standards: General requirements regarding reference standards, including a listing of reference standard-issuing organizations (and their acronyms) used in the Contract Documents.

1.2 REFERENCES

- A. Contract Language Addressed to Contractor:
1. Unless expressly indicated otherwise, language of the Contract Documents addresses Contractor, and the Contract Documents show and indicate Contractor's obligations.
 2. Unless indicated otherwise, expressions such as, "provide", "furnish", "install", "perform", "retain services of", "remove", "demolish", "replace", and the like refer to Contractor's obligations under the Contract.
- B. Defined Terms:
1. Defined terms, indicated with initial capital letters or with all-capital letters, used in the Contract Documents, are indicated in the General Conditions, as may be modified by the Supplementary Conditions. Additional defined terms, if any, in general use in the Contract Documents are indicated below. Where used, such defined terms apply to the singular and plural thereof.
 - a. None.
 2. Additional defined terms, applicable to the Work of a given Specifications Section, may be indicated in the associated Specifications Section.
- C. Terminology:
1. Terminology, indicated without initial capital letters, used in the Contract Documents, are indicated in the General Conditions, as may be modified by the Supplementary Conditions. Additional terminology in general use in the Contract Documents are indicated below. Where used, such terminology applies to the singular and plural thereof.
 - a. "Shown" means information or requirements presented on the Drawings, in schedules, or in other types of graphic instruments.
 - b. "Indicated" means, as applicable: (1) graphic representations, notes, or schedules on the Drawings, or (2) other paragraphs, provisions, tables, or schedules in the Specifications and elsewhere in the Contract Documents.
 - c. "Specified", "noted", "scheduled", and similar terms, have the same meaning as "shown" and "indicated", as applicable, and are used to help the user locate the reference without limitation on the location.
 - d. "Installer", "applicator", or "erector" is Contractor's employees or Subcontractor, engaged to perform a specific construction activity, including installation, erection, application, or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
 - e. "Experienced", when used in conjunction with terms such as "installer", "Subcontractor", "Supplier", "manufacturer", and similar terms means (unless

expressly indicated otherwise for the subject Work elsewhere in the Contract Documents) such person or entity, as applicable, has successfully completed not less than five previous projects similar in size, scope, and complexity to such person's or entity's work on this Project; being familiar with the special requirements indicated and required; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with written requirements of the Supplier of the material or equipment being installed.

- f. "Assigned specialists" and similar terms: Certain Specifications require specific construction activities be performed by specialists with recognized, extensive experience in such operations. Engage said specialists for such activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.
 - g. Trades: Use of terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter", unless otherwise indicated in the Contract Documents or required by Laws or Regulations, or required by an applicable project labor agreement. Such terminology also does not imply that indicated requirements apply exclusively to trade personnel of the corresponding generic name..
2. Additional terminology, applicable to the Work of a given Specifications Section, may be indicated in the associated Specifications Section.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. References in the Contract Documents to local building and construction code(s) means the following:
 - a. City of Ketchum, Idaho – Code of Ordinances, Title 15 – Buildings and Construction.

1.4 REFERENCED STANDARD SPECIFICATIONS AND CONSTRUCTION GUIDELINES

- A. Except as otherwise shown or indicated in the Contract Documents, the Work shall comply with the Contract Documents and the following referenced specifications and construction guidelines:
 1. Code of Ordinances, Title 15 – Buildings and Construction by City of Ketchum, which can be obtained at Ketchum City Hall.
 2. Idaho Standards for Public Works Construction (ISPWC) Standard Specifications, 2020 Edition. ISPWC 2020 Edition can be purchased online on the Local Highway Technical Assistance Council (LHTAC) website at Contractor's (non-compensable) cost. Standard Specifications' bidding and contracting requirements do not apply to this Contract.
- B. Engineer is not the author of, is not responsible for, and did not seal and sign the referenced specifications and construction guidelines indicated above. Such referenced specifications and construction guidelines are not part of the Contract Documents. Where compliance with referenced specifications or construction guidelines is required by the Contract but requirements are unclear or conflict with requirements of the Contract Documents, submit to Engineer request for interpretation or clarification.
- C. Maintain at the Site complete copy (in either paper or electronic form) of referenced specifications and construction guidelines indicated above. Make such copy available for Engineer's, Resident Project Representative's (RPR), or Owner's Site Representative's (OSR) use in Contractor's field office at the Site.

1.5 ABBREVIATIONS.

A. Abbreviations - General:

1. Abbreviations commonly used in the Contract Documents are indicated in this Article or on the Drawings, except as further indicated in the following paragraphs.

2. Additional abbreviations, specific to the Work of a given Specifications section, may be indicated in the associated Specifications.
3. Typical equipment abbreviations are indicated in Section 01 61 03 - Equipment - Basic Requirements.
4. Piping system abbreviations are indicated in Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

B. Common abbreviations that may be used in the Contract Documents are indicated below, alphabetically by their written-out meaning:

alternating current	AC
ampere	A, or amp
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
Architectural Barriers Act	ABA
average	avg
biochemical oxygen demand	BOD
five-day biochemical oxygen demand	BOD ₅
brake horsepower	Bhp or BHP
British thermal unit	Btu
building information model	BIM
carbonaceous biochemical oxygen demand	CBOD
five-day carbonaceous biochemical oxygen demand	CBOD ₅
chemical oxygen demand	COD
Celsius (or Centigrade)	C
chlorinated polyvinyl chloride	CPVC
chlorofluorocarbons	CFC
Code of Federal Regulations	CFR
computer-aided drafting and design	CADD, or CAD
cubic inch	cu in, or CU IN, or in ³
cubic foot	cu ft, or CU FT, cf, CF, or ft ³
cubic yard	cu yd, or CU YD, or CY, or yd ³
cubic feet per minute	CFM, or cfm
cubic feet per second	CFS, or cfs
decibel	dB, dBA, or dBa
degree Celsius	degrees C, °C, or deg C
degrees Fahrenheit	degrees F, °F, or deg F
diameter	dia

direct current	DC
dollars	\$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft or FT
feet per hour	FPH, or ft/hr
feet per minute	FPM or ft/min
feet per second	fps, or ft/s
figure	fig
flange	flg
foot-pound	ft-lb or FT-LB
gallon	gal or GAL
gallons per hour	GPH, gph, or gal/hr
gallons per minute	GPM, or gpm
gallons per second	GPS, or gps
gram	g
grams per liter	g/L
heating, ventilating, and air conditioning	HVAC
Hertz	Hz
horsepower	hp or HP
hour	hr or HR
human-machine interface	HMI
inch	in. or IN
inches of mercury	in. Hg
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID
iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi or KSI
kilovolt-ampere	kva, or kVA
kilowatt	Kw, or
kilowatt-hour	Kwhr, kWhr, or kwh, kWh
linear foot	lin ft or LF

liter	L
Leadership in Energy and Environmental Design (USGBC)	LEED
maximum	max
mercury	Hg
mile	mi
miles per hour	mph or MPH
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	MGD or MGD
million gallon	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nitrogen oxide (total concentration of mono-nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO ₂))	NOx
nominal pipe size	NPS
number	no. or #.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	PPH, or pph
parts per million	PPM, or ppm
parts per billion	PPB, or ppb
polychlorinated biphenyl	PCB
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb, LB, lbs, or LBS
pounds per square inch	PSI, or psi
pounds per square inch absolute	PSIA, or psia
pounds per square inch gauge	PSIG, or psig

pounds per square foot	PSF, or psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	RPM, or rpm
second	sec, or s
specific gravity	sp gr, or SG
square	sq
square foot	sq ft, or SQ FT, or sf, or ft ²
square inch	sq in., or SQ IN, or in ²
square yard	sq yd, or SY, or yd ²
standard	std
standard cubic feet per minute	SCFM, or scfm
total dynamic head	TDH
totally-enclosed fan-cooled	TEFC, or tefc
volt	V
volts alternating current	VAC, or vac
volts direct current	VDC, or vdc
volatile organic compounds	VOC

1.6 REFERENCE STANDARDS AND ORGANIZATIONAL ACRONYMS

A. Reference Standards - General:

1. Each entity engaged in the Work, including Contractor, Subcontractors, and Suppliers, shall be familiar with reference standards applicable to its portion(s) of the Work. Comply with such reference standards when required by the Contract Documents or appropriate fabrication and construction practice, unless the Contract Documents requirements exceed those of the associated reference standard.
2. Refer to the General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents.
3. Provisions of reference standards are in effect in accordance with the Specifications and other provisions of the Contract Documents where reference standards are cited.
4. Copies of applicable reference standards are not included in or bound with the Contract Documents. Where reference standards are needed for the Work, obtain such reference standards(s) from the publication source.

B. Organization Names and Acronyms:

1. Where reference standards, specifications, manuals, Laws or Regulations, or other published data of international, national, regional, or local organizations are cited in the Contract Documents, the organization issuing the standard (or other type of document) may be referred to by its acronym only.
2. The following acronyms that may appear in the Contract Documents shall have the meanings indicated below, unless expressly indicated otherwise in that part of the Contract Documents where such standard (or other document) is cited.
3. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (AFBMA))
ACI	American Concrete Institute
ACS	American Chemical Society
ADSC-IAFD	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
AGI	American Geosciences Institute
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AIPG	American Institute of Professional Geologists
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
AMPP	Association for Materials Protection and Performance
ANSI	American National Standards Institute
APA	The Engineered Wood Association
APHA	American Public Health Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ARS	American Rail Standard
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CASE	Coalition of American Structural Engineers (part of the American Council of Engineering Companies (ACEC))
CBMA	Certified Ballast Manufacturers Association
CBP	United States Customs and Border Protection
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DBIA	Design-Build Institute of America
DHS	United States Department of Homeland Security
DIN	Deutsches Institut für Normung, eV (German Institute for Standardization)u
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FAA	Federal Aviation Administration (US Department of Transportation)

FCC	United States Federal Communications Commission
FEMA	Federal Emergency Management Agency (US Department of Homeland Security)
FHWA	Federal Highway Administration (US Department of Transportation)
FIDIC	International Federation of Consulting Engineers
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
FTA	Federal Transit Administration, United States Department of Transportation
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers
ISA	International Society of Automation
ISI	Institute for Sustainable Infrastructure
ISO	Insurance Services Office
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NAVFAC	Naval Facilities Engineering Command (US Navy)

NBHA	National Builders Hardware Association
NBS	National Bureau of Standards (United States Department of Commerce)
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	National Institute of Standards and Technology (United States Department of Commerce)
NLGA	National Lumber Grades Authority
NRC	United States Nuclear Regulatory Commission
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSPE	National Society of Professional Engineers
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration, United States Department of Labor
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
RUS	Rural Utility Service (division of Rural Development of the USDA)
SAE	Society of Automotive Engineers

SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings (formerly, Steel Structures Painting Council)
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TSA	Transportation Security Administration (United States Department of Homeland Security)
UCC	Uniform Commercial Code
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USACE	United States Army Corps of Engineers (also abbreviated as COE or USACOE)
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
WDMA	Window and Door Manufacturers Association
WEF	Water Environment Federation (formerly the Water Pollution Control Federation)
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTIONS AND TESTING PROGRAM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Contractor responsibilities for special inspection and testing.
 2. Special Inspection program and reporting requirements.
 3. Attachment A to this Specification Section includes the Submittal of Special Inspections.
 4. Attachment B to this Specification Section includes Special Inspector qualifications, reporting requirements, and material specific inspections and tests.
 - a. This information is for the Contractor reference only and is not part of the Contract Documents.
 - b. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
 - c. The Service Provider(s) responsible for the Owner-provided Services will be selected after Contract award.
- B. Purpose:
1. This Document was developed to address the requirements of the 2018 International Building Code IBC, section 1704.1, including:
 - a. One or more special inspectors will be hired by the Owner or the Owner's Agent to provide inspections during constructions on the types of work listed under Section 1704.
 2. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This statement is included as Attachment A to this Specification. Attachment B includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.
- C. Related Specification Sections include but are not necessarily limited to:

1.2 DEFINITIONS

- A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.
- B. Testing Agency: Approved agency, not affiliated or hired by the Contractor, which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.
- C. Statement of Special Inspections: Document provided to the Building Code Official outlining special inspections and tests to be done on the project and frequency of required test.
- D. Soils Engineer or Geotechnical Engineer: For the purposes of Special Inspection "Soils Engineer," "Geotechnical Engineering," and "Special Inspector" shall be interchangeable as pertains to the Division 31 specifications.
- E. NICET: National Institute for Certification in Engineering Technologies.

1.3 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.
1. Providing access to the work shall include all labor and facilities to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.

2. Provide means to obtain and handle samples taken on site.
- B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.
- C. Notify special inspector and/or testing agency of work to be inspected/tested minimum of 24 hours prior.
- D. Work for which special inspections are required shall remain accessible and exposed for the purposes of special inspections until completion of required special inspections.
- E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions of the work shall not be covered or concealed until authorized by Owner's Representative.
- F. Work to be inspected should be complete at time of inspector's arrival on-site.
- G. Payment for Special Inspection services will be in accordance with the following:
 1. Payment described below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.3 A.
 2. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
 - a. Inspection reveals work is satisfactory.
 - b. Owner pays all costs associated with this inspection.
 3. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
 - a. Inspection reveals work is deficient.
 - b. Contractor corrects deficiencies within timeframe defined in Item 4) below.
 - c. Work is re-inspected and work is satisfactory.
 - d. Owner pays all costs associated with this inspection.
 4. After Contractor notification, inspector arrives at site and work is not ready for inspection when inspector arrives.
 - a. Inspector will remain on-site for a maximum of 2 hours awaiting the completion of the work.
 - b. If work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection.
 - c. All costs associated with this inspection trip will be charged to the Contractor.
 5. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined above.
 - a. Inspection reveals work is deficient.
 - b. Contractor attempts to correct deficiencies within 2 HR timeframe and calls for re-inspection.
 - c. Work is re-inspected and found to still be deficient.
 - d. Inspector will be dismissed.
 - e. All costs associated with this inspection trip will be charged to the Contractor.
 6. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of failed test areas requiring retesting are the sole responsibility of the Contractor. For additional specific payment requirements for soils see the respective Division 31 Section.
- H. Special Inspection is intended to be an independent quality assurance. Special Inspections shall not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty responsibilities. Contractor's own personnel shall review all work to be inspected for conformance with Contract Documents prior to calling for inspection.

1.4 REPORTING DUTIES AND AUTHORITY

- A. A pre-construction meeting to coordinate and clarify inspection, testing, and procedural requirements will be held per Section 01 42 00.
 1. The meeting is to be attended by:

- a. Owner.
 - b. Engineer.
 - c. Building Code Official or designee.
 - d. Testing Agency and Special Inspectors.
 - e. General Contractor.
 - f. Appropriate Sub-contractor(s).
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
- 1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

**ATTACHMENT A TO SECTION 01 45 33
SUBMITTAL OF SPECIAL INSPECTIONS**

Statement Date: [____]

Project Name: Ketchum / SVSWD WRF Aeration Upgrades
Project Address: 110 River Ranch Road, Ketchum, Idaho, 83340
Owner: City of Ketchum and Sun Valley Water and Sewer District
Registered Design Professional in Responsible Charge (DPRC): Ron F. Manske

The Statement of Special Inspections (Statement) is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the Building Code. The Special Inspection program is outlined in Specification Section 01 45 33 and Attachments A and B. A detailed explanation of the requirements for Special Inspections and Testing can be found in specification Section 01 45 33 of the Project Manual in conjunction with the Technical Specifications for each material.

Bi-weekly Special Inspection reports will be submitted to the DPRC and the Building Official. Discovered discrepancies will be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies will be brought to the attention of the DPRC and the Building Official. Only documents that are prepared and signed or sealed by the Special Inspectors (SI) are valid.

The SI is responsible for verifying all information on each document prior to signing or sealing and directly forwarding it to the DPRC and Building Official. The SI is responsible for verifying all inspectors under his supervision maintain current certifications during the course of the project. At the conclusion of each individual Special Inspection type, the SI will complete a Final Report.

The Special Inspection program does not relieve the Contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety. The Contractor is solely responsible for construction means, methods, and job site safety. Failure to adhere to the SI program as outlined herein may result in a stop work notice being issued by the Building Official.

Respectfully submitted,
Design Professional in Responsible Charge,

Ronald F. Manske, PE
Type or Print Name

Idaho License # 21207
Expires: January 31, 2024

Signature

Date

END OF ATTACHMENT A

ATTACHMENT B TO SECTION 01 45 33
SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING
REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 41 33 - Precast and Prestressed Concrete.
 - 5. Section 04 22 00 - Concrete Masonry.
 - 6. Section 05 50 00 - Metal Fabrications.
 - 7. Section 07 24 13 - Polymer-Based Exterior Insulation and Finish System (EIFS).
 - 8. Section 07 84 00 - Firestopping.
 - 9. Section 31 23 00 - Earthwork.

1.2 QUALIFICATIONS

- A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.
- B. All Special Inspections and Testing to be done under the direction of a Professional Engineer or Registered Architect registered in the State of Idaho herein referred to as Registered Professional for Special Inspections (RPSI).
- C. Soil, concrete, masonry, mortar, grout, steel and aluminum related testing.
 - 1. The Testing Agency shall have a minimum of 10 years experience in the testing of these materials.
 - 2. The Testing Agency's technician(s) conducting this testing:
 - a. Shall have a minimum of five years experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
 - 3. Concrete related work:
 - a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field Testing Technician – Grade 1.
- D. Special Structural Inspections:
 - 1. Professional Engineers or Architects, licensed in the State of Idaho, may perform special inspections in accordance with their license qualifications.
 - 2. Other individuals, working under the direct supervision of a licensed engineer and meeting the following qualifications, may perform special inspections.
 - 3. Soils related work:
 - a. NICET Level II Certification in geotechnical engineering technology/construction; or
 - b. Registered Geologist; or
 - c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
 - 4. Concrete related work:
 - a. International Code Council certification for Reinforced Concrete Special Inspector or American Concrete Institute Concrete Construction Special Inspector.
 - b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed Professional Engineer.
 - 5. Precast concrete erection related work:
 - a. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
 - 6. Precast concrete erection welding:
 - 1) American Welding Society as a Certified Welding Inspector; or

- 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or
 - 3) NDT Level II or II Certificate (for non-destructive testing only).
7. Masonry related work:
 - a. Shall be certified by the International Code Council or American Concrete Institute for structural masonry and one year of related experience.
 - b. Alternatively, may be an Engineer Intern with a minimum of two years appropriate training.
 8. Steel and aluminum related work:
 - a. Frame and material verification:
 - 1) AISC 360
 - 2) AA - ADM1-2015
 - b. Welding:
 - 1) American Welding Society as a Certified Welding Inspector; or
 - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or
 - 3) NDT Level II or II Certificate (for non-destructive testing only).
 - c. High strength bolting:
 - 1) International Code Council Structural Steel and Welding Certification and one year related experience.
 - 2) Alternatively, may be an Engineer Intern with appropriate training.
 9. Fire resistive coating (intumescent paint) related work:
 - a. International Code Council Spray-Applied Fireproofing Certification and three years of related experience; or
 - b. International Code Council Fire Inspector 1 Certification and three years of related experience.
 10. Other equivalent certifications will not be acceptable unless approved by the Engineer.

1.3 REPORTING DUTIES AND AUTHORITY

- A. Reporting requirements for special inspector per IBC 2018 for Building System Related Work.
 1. Comply with requirements of IBC Section 1704..
 2. Provide written documentation of all inspections and testing.
 - a. Include exact location of work.
 - b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
 3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager and the Owner's on-site representative.
 - a. Indicate that work inspected was done in conformance with approved construction documents.
 - b. Immediately report any discrepancies to the Contractor for correction.
 - c. If the discrepancies are not corrected in a timely fashion, notify the Engineer's Project Manager and Owner's on-site representative.
 4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two weeks (14 calendar days).
 - a. Copy will be available to:
 - 1) Engineer's Project Manager.
 - 2) Owner.
 - 3) The Building Code Official.
 - 4) General Contractor.
 5. At the end of the Project, the RPSI shall compile all test reports for each inspected material and for each Special Inspector and summarize into a single PDF and submit to the Engineer and Building Code Official.
 - a. Final summary report to be signed and sealed by a Registered Professional for Special Inspections stating:
 - 1) The required Special Inspections have been performed.

- 2) All discrepancies have been resolved except as specifically stated in the summary report.
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
 1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

1.4 MATERIAL SPECIFIC SPECIAL INSPECTIONS AND TESTS

- A. Material specific requirements for special inspection and testing are listed in the technical specifications listed below. Special inspection and testing requirements will be located in each appropriate technical specification under "SOURCE QUALITY CONTROL", "FIELD QUALITY CONTROL" and/or "QUALITY ASSURANCE" as appropriate for each material.

1.5 SOILS

- A. Special Inspection/testing will be provided per IBC Section 1705.6 and Table 1705.6 as required to determine that the site has been prepared in accordance with the approved soils report, and to verify the allowable soil bearing pressure, materials, compaction densities, trenching and backfill and conformance to the project Specifications.
- B. Inspection/testing requirements are listed separately in Specification Division 31 and are indicated as the work to be done by the Geotechnical Engineer, Testing Agency, or Special Inspections and Testing Provider.

1.6 CONCRETE

- A. Special Inspection and testing will be provided per IBC Table 1705.3. Inspection is required for material verification, reinforcing steel, embedded bolts, mechanical splices, concrete tests, welding of reinforcing, concrete placement and curing, and waterstop placement.
- B. Inspection and testing requirements are listed separately in Specification Section 03 05 05 and are indicated as the work to be done by the Special Inspector or Testing Agency.

1.7 PRECAST CONCRETE

- A. Special Inspection and testing will be provided per IBC Table 1705.3 Items 9, 10, and 11. Inspection and testing is required for connection embed number and placement, connection welding, and proper panel detailing prior to placement.
- B. Inspection requirements are listed separately in Specification Section 03 41 33 and are indicated as the work to be done by the Special Inspector.

1.8 MASONRY

- A. Special Inspection and testing will be provided per IBC Section 1705.4. Inspection is required for material tests and verification, reinforcing steel, embedded bolts and anchorage, grout placement, and welding of reinforcing.
- B. Inspection/testing requirements are listed separately in Specification Section 04 22 00 and are indicated as the work to be done by the Special Inspector.

1.9 STEEL, STAINLESS STEEL, AND ALUMINUM

- A. Special Inspection will be provided for structural steel and aluminum per IBC Section 1705.12.1.2. Inspection is required for material verification, high-strength bolting, welding and other work noted on the Contract Documents.

1.10 EXTERIOR FINISH AND INSULATION SYSTEM (EIFS)

- A. Special Inspection will be provided per IBC Section 1705.16.

- B. Inspection requirements are listed separately in Specification Section 07 24 13 and are indicated as the work to be done by the Special Inspector

1.11 MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS

- A. Special Inspection will be provided per IBC Section 1705.15 as required to determine that the mastic and intumescent fire-resistant coatings have been installed in conformance with the Contract Documents.
- B. Inspection requirements are listed separately in Specification Section 07 84 00 and are indicated as the work to be done by the Special Inspector.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF ATTACHMENT B

SECTION 01 51 05
TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Temporary electricity.
 2. Temporary lighting.
 3. Temporary communications.
 4. Temporary heating, cooling, ventilating, and temporary enclosures.
 5. Temporary water supply.
 6. Temporary sanitary facilities.
 7. Temporary first-aid facilities.
 8. Temporary fire protection.
- B. Scope:
1. Contractor shall provide all temporary utilities and temporary facilities required for the Project, including those indicated in this Specifications section.
 2. Make all arrangements with utility owners for temporary utilities and with others as appropriate for temporary facilities. Obtain required permits and approvals for temporary utilities and temporary facilities.
 3. Pay all service costs for utilities and facilities indicated in this Specifications section as Contractor's responsibility, including cost of electricity, water, fuel, and other utility services and temporary facilities required for the Work.
 4. Continuously maintain adequate temporary utilities and temporary facilities for all purposes for the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities and temporary facilities through Substantial Completion and removal of temporary field offices and sheds unless otherwise approved in writing by Engineer.
 5. Should Owner occupy part of the Work prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by Owner will be shared proportionately by Owner and Contractor as mutually agreed to by the parties.
 6. Maintain, including cleaning, temporary utilities and temporary facilities, and continuously provide consumables as necessary.
 7. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and the needs of the Project.
 8. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and requirements of authorities having jurisdiction and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

- A. Temporary Electricity:
1. Provide temporary electric service necessary for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.
 2. Temporary Electricity for Field Offices and Sheds:
 - a. Provide temporary electric service for Contractor field offices.
 3. Temporary Electricity for Work in Existing Buildings:
 - a. Contractor may use existing 120 V convenience receptacles in Owner's existing building spaces for items such as small hand tools. Contractor need not sub-meter or reimburse Owner for use of existing 120 V service.

- b. Contractor shall provide its own temporary electric power source independent of Owner's system for uses such as welding and other temporary electricity demands requiring greater than 120 V, single-phase power, and during times when power to existing facility is completely shut down. Contractor's temporary generators shall have appropriate environmental controls and shall be properly-located and properly-vented to avoid posing hazards to personnel and property.
- B. Temporary Lighting:
 - 1. Do not work in areas with insufficient lighting. Where lighting is insufficient for the work activities to be performed, provide additional temporary lighting.
 - 2. Provide temporary lighting sufficient for observation of the Work by Engineer and inspection by Contractor, entities performing code-required tests and special inspections, and authorities having jurisdiction. Where required by Engineer, provide additional temporary lighting.
- C. Temporary Communications:
 - 1. Provide temporary telephone service and communications necessary for Contractor's operations at the Site and for summoning emergency medical assistance and other first-responders as necessary.
- D. Temporary Heating, Cooling, Ventilating, and Enclosures:
 - 1. Provide sufficient temporary heating, cooling, and ventilating and temporary enclosures to ensure safe working conditions and prevent damage to existing property and the Work.
 - 2. Except where otherwise specified, temporary heating shall maintain temperature of the space served between 50 degrees F and maximum design temperature of building or facility and its contents.
 - 3. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier's recommended temperature and humidity ranges for storage, application, or installation, as appropriate.
 - 4. Temporary Welding Enclosures:
 - a. Provide temporary welding enclosures and partitions required to maintain required temperature and humidity.
 - b. Temporary enclosures shall be sufficiently sturdy and durable for the intended use and duration. Maintain and repair temporary welding enclosures as necessary.
- E. Temporary Water:
 - 1. General:
 - a. Provide temporary water service and facilities including piping, valves, meters if not provided by Owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as necessary to prevent freezing of temporary services.
 - b. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water systems.
 - 2. Water for Construction Purposes:
 - a. Provide water for Site maintenance and cleaning and, water necessary for construction activities, and water for disinfecting and testing of systems.
 - b. Contractor may use existing hose bibs for short-term wash-downs and intermittent use of water for work areas in existing building and existing structures. Obtain consent of Engineer and Owner if connections to existing hose bibs and similar existing connections will be used for more than one day at a time.
 - 3. Water for Human Consumption and Sanitation:
 - a. Provide potable water in accordance with Laws and Regulations for consumption by personnel at the Site, for field offices, and for sanitary facilities.
 - b. When necessary, provide bottled, potable water for use and consumption by personnel at the Site, including Contractor, Engineer, and visitors to the Site.

- F. Temporary Sanitary Facilities:
 - 1. Provide suitably-enclosed chemical or self-contained toilets for Contractor’s employees, Subcontractors, Suppliers, Engineer, and visitors to the Site. Location of temporary toilets shall be acceptable to Owner and Engineer.
 - 2. Refer to Paragraph 1.2.E of this Specification Section for requirements for temporary water service intended for human consumption during construction.
 - 3. Provide suitable temporary washing facilities for employees and visitors.
- G. Temporary First-aid Facilities.
 - 1. Provide temporary first-aid stations at or immediately adjacent to the Site’s work areas, and inside Contractor’s field office. Locations of temporary first-aid stations shall be determined by Contractor’s safety representative. Replenish supplies in first-aid stations as items are used, prior to expiration of items, and as necessary. Monitor and log inventory of supplies in temporary first-aid stations not less than once per week.
 - 2. Provide list of emergency telephone numbers at each hardwired telephone at the Site.
- H. Temporary Fire Protection.
 - 1. Provide temporary fire protection in accordance with Laws and Regulations and the requirements of this Specifications section.
 - 2. For work areas without standpipe fire protection systems, during construction provide portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10 – Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
 - 3. Provide Class A (ordinary combustibles), Class B (combustible liquids and gases), and Class C (electrical equipment) fire extinguishers as necessary.
 - 4. Comply with NFPA 241 – Standard for Safeguarding Construction, Alternation, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

1.3 USE OF OWNER’S SYSTEM

- A. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner’s written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.
- B. Use of Permanent Utility Systems Provided Under the Project:
 - 1. Permanent electrical, lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
 - a. Obtain Owner’s written permission to use permanent systems.
 - b. Permanent systems to be used for temporary utilities or temporary facilities shall be substantially complete, including complete functionality of all controls. Engineer will not certify Substantial Completion for facilities and systems used solely by Contractor during construction.
 - c. Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
 - 2. Do not use the following permanent facilities:
 - a. Telephone and communication facilities.
 - b. Sanitary facilities.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for temporary utilities and temporary facilities:
 - 1. may be new or used but, if used, shall be in good condition;
 - 2. shall be adequate for purposes intended;
 - 3. shall not create unsafe or unsanitary conditions; and

4. shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, cabling, supports, controls, and appurtenances.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install temporary utilities and temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Utilities and Temporary Facilities:
 1. Locate temporary systems for proper function and service.
 2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility owners and others.
 3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.
- C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

- A. Maintain temporary systems to provide safe, continuous service as necessary and as required.
- B. Properly supervise operation of temporary systems:
 1. Enforce compliance with Laws and Regulations.
 2. Enforce safe practices.
 3. Prevent abuse of services.
 4. Prevent nuisances and hazards caused by temporary systems and their use.
 5. Prevent damage to finishes.
 6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.
- C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient for continuous operation.

3.3 REMOVAL

- A. Completely remove temporary utilities, temporary facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not otherwise specified, restore to preconstruction condition.
- B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner. If utility owner will perform such work, coordinate with and pay utility owner for such work.
- C. Where permanent utilities and systems were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

END OF SECTION

SECTION 01 61 03
EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.
- B. Related Sections include but are not necessarily limited to:
1. Section 01 81 10 - Wind and Seismic Design Criteria.
 2. Section 03 15 19 - Anchorage to Concrete.
 3. Section 05 50 00 - Metal Fabrications.
 4. Section 09 96 00 - High Performance Industrial Coatings.
 5. Section 10 14 00 - Identification Devices.
 6. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 7. Section 40 05 51 - Valves - Basic Requirements.
 8. 40 90 00 - Instrumentation for Process Control - Basic Requirements.
 9. 41 22 23 - Hoists, Trolleys, and Monorails.
 10. 43 21 00 - Pumping Equipment - Basic Requirements.
 11. 46 41 00 - Mixers.
 12. 46 51 00 - Aeration Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Bearing Manufacturers Association (ABMA).
 2. American Gear Manufacturers Association (AGMA).
 3. American Petroleum Institute
 - a. API 686 - Recommended Practice for Machinery Installation and Installation Design
 4. ASTM International (ASTM):
 - a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
 - b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 5. Hydraulic Institute (HI):
 - a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
 6. International Electrotechnical Commission (IEC).
 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
 8. International Organization for Standardization (ISO):
 - a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
 - b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
 9. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 6, Enclosures for Industrial Control and System.
 - c. MG 1, Motors and Generators.
 10. InterNational Electrical Testing Association (NETA):
 - a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
 11. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):

12. National Institute for Certification in Engineering Technologies (NICET).
 13. National Institute of Standards and Technology (NIST).
 14. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
 15. Underwriters Laboratories, Inc. (UL).
 - a. 508, Standard for Safety Industrial Control Equipment.
 - b. 508A, Standard for Safety Industrial Control Panels.
 - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
 16. Vibration Institute.
- B. Supplier's Vibration Analyst:
1. Supplier's vibration analyst shall prepare pre-Shop Drawing vibration analysis of equipment.
 2. Where required, Supplier's vibration analyst shall be either equipment manufacturer's qualified employee or independent business entity whose sole business, or principal part of its business, is evaluating and determining natural frequencies of rotating equipment.
 3. Shall possess not less than 10 years' relevant experience.
 4. Supplier's Vibration Analyst's Professional Engineer:
 - a. Vibration analysis shall be performed by, or under the direct, personal supervision of, professional engineer licensed and registered in the State of Idaho experienced in preparing finite element analyses, rotodynamic analyses, and experimental modal analysis similar to that required for the Work.
 - b. Professional engineer shall possess not less than five years' combined experience in field testing and data analysis for vibration analysis.
 - c. Vibration analysis professional engineer's seal and signature, with indication of date seal and signature were applied to the subject document, shall clearly appear on all results and reports furnished as Submittals.
- C. Field Vibration Testing Subcontractor:
1. Field vibration testing Subcontractor shall, where required by the Contract Documents, perform vibration testing of equipment installed at the Site and perform associated vibration analyses.
 2. Vibration testing Subcontractor shall be an independent entity that has performed as its sole business, or principal part of its business, for not less than 10 years, inspection, testing, calibrating, adjusting equipment and systems, and performing vibration testing of equipment.
 3. Entities whose principal business is one or more of the following are not considered independent vibration testing entities and, therefore, shall not be field vibration testing Subcontractor:
 - a. Motor sales, service, or repairs.
 - b. Process equipment sales, service, or repairs.
 4. Acceptable entities include, but are not necessarily limited to:
 - a. AVS Engineering: <https://www.avsengeering.net/>
 - b. Engineering Testing Services: <https://etestinc.com/>
 - c. Maritech, LLC: <http://www.maritech-llc.com/contact.html>
 - d. Or equal.
 5. Field vibration testing Subcontractor must have an established program for monitoring and testing equipment calibration, with accuracy traceable in an unbroken chain, in accordance with NIST requirements.
 6. Field Personnel: Each person employed for field vibration testing on the Work shall possess not less than the following qualifications:
 - a. Three years' field experience covering all phases of field vibration testing and data gathering.

- b. Current, valid Vibration Category II certification from Vibration Institute or a licensed, registered professional engineer.
- 7. Analysis Personnel: Personnel performing analysis for field vibration testing Subcontractor shall possess not less than the following qualifications:
 - a. Five years' combined field testing and data analysis experience.
 - b. Current, valid Vibration Category III certification from the Vibration Institute or a professional engineer licensed and registered in in the same jurisdiction as the Site. Where required by Laws and Regulations, field vibration analysis report shall be sealed, signed, and dated by professional engineer who personally prepared, or exercised personal, supervisory control over subordinates in preparing, the field vibration analysis report.
- 8. Analysis Equipment: Field vibration testing Subcontractor shall have access to and use, where appropriate, the following testing equipment, properly maintained and calibrated:
 - a. Impact Hammer:
 - 1) Frequency Range: 1 kHz.
 - 2) Range (5v output) 5,000 pounds-force (22,200 newtons).
 - 3) Hammer sensitivity (approx.) 1mV/lbf (0.23 mV/N)
 - b. Analyzer:
 - 1) Frequency Range: 1 Hz to 10,000Hz.
 - 2) Frequency Accuracy: 0.02 percent.
 - 3) Non-Integrated Spectral Amplitude Accuracy: 5 percent, 3 Hz to 65 Hz.
 - 4) Single Integrated Spectral Amplitude Accuracy: 5 percent, 10 Hz to 20 Hz.
 - 5) Supports measurements of acceleration, velocity, and displacement.
 - c. Vibration Sensor:
 - 1) Sensitivity: ± 5 percent = 100 mV/g
 - 2) Acceleration Range: ± 5 g.
 - 3) Amplitude Nonlinearity: ± 1 percent
 - 4) Frequency Response: ± 10 Hz to 7kHz (± 3 dB)
 - d. Data logging equipment for simultaneous recording of the following data points:
 - 1) Vibration in the X, Y, and axial planes (for all pumps pursuant to ANSI/HSI Standard).
 - 2) Digital tachometer recording RPM.
 - 3) Discharge Pressure Transmitter
 - a) Accuracy: 0.3 percent of range
 - b) Fluid Temperature Range: 32 to 100 DegF
 - 4) Suction Pressure Transmitter (when other than submersible pump or vertical turbine (suspended) pump.
 - a) Accuracy 0.35 percent of range.
 - b) Fluid Temperature Range: 32 to 100 DegF.
 - c) For submersible pumps and vertical turbine (suspended) type pumps, suction liquid surface level signal from Site's monitoring and control system (e.g., plant PLC/SCADA system).
 - 5) For pumps, pumping rate (flow) signal from Site's monitoring and control system (e.g., plant PLC/SCADA system)
 - 6) Equipment/motor bearing temperature signal from Site's monitoring and control system (e.g., plant PLC/SCADA system)).
 - 7) Pump/motor vibration signal from Site's monitoring and control system (e.g., plant PLC/SCADA system).

D. Infrared Thermography Testing Program:

- 1. Testing firm:
 - a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
 - b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.

2. Field personnel:
 - a. Minimum of one year field experience covering all phases of field thermography testing and data gathering.
 - b. Supervisor certified by NETA or NICET.
 3. Analysis personnel:
 - a. Minimum three years combined field testing and data analysis experience.
 - b. Supervisor certified by NETA or NICET.
- E. Electrical Equipment and Connections Testing Program:
1. Qualification requirements as specified in section 26 05 00 – General Requirements for Electrical Work.
- F. Miscellaneous:
1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
 - a. More than one manufacturer is listed for a given "product" in Specifications.
 - b. No manufacturer is listed.
 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power Drawings and defined in the Electrical specifications.
 3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and verify their compatibility.

1.3 DEFINITIONS

- A. Product: Manufactured materials and equipment.
- B. Major Equipment Supports - Supports for Equipment:
1. Located on or suspended from elevated slabs with supported equipment weighing 2,000 pounds or greater, or;
 2. Located on or suspended from roofs with supported equipment weighing 500 pounds or greater, or;
 3. Located on slab-on-grade or earth with supported equipment weighing 5,000 pounds or more.
- C. Equipment:
1. One or more assemblies capable of performing a complete function.
 2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
 3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.
- D. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.
- E. Baseplate or equipment base plate or machine base
1. Are fabricated frames of structural shapes and plates with enough strength and sturdiness to serve as the surface to which other equipment is attached to and supported by. Baseplates can be directly mounted and grouted to concrete equipment support bases or machined and bolted to a sole plate.
- F. Sole plate
1. A thick steel machined plate that is attached to and grouted to a concrete equipment support base.
 2. Base plates are bolted to a sole plate when a sole plate is specified and/or provide.

1.4 SUBMITTALS

A. Shop Drawings:

1. General for all equipment:
 - a. Data sheets that include manufacturer's name and complete product model number.
 - 1) Clearly identify all optional accessories that are included.
 - b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
 - c. Manufacturer's delivery, storage, handling, and installation instructions.
 - d. Equipment identification utilizing numbering system and name utilized in Drawings.
 - e. Equipment installation details:
 - 1) Location of anchorage.
 - 2) Anchorage setting templates.
 - 3) Manufacturer's installation instructions.
 - f. Equipment area classification rating.
 - g. Shipping and operating weight.
 - h. Equipment physical characteristics:
 - 1) Dimensions (both horizontal and vertical).
 - 2) Materials of construction and construction details.
 - i. Equipment factory primer and paint data.
 - j. Manufacturer's recommended spare parts list.
 - k. Equipment lining and coatings.
 - l. Equipment utility requirements include air, natural gas, electricity, and water.
 - m. Ladders and platforms provided with equipment:
 - 1) Certification that all components comply fully with OSHA requirements.
 - 2) Full details of construction/fabrication.
 - 3) Scaled plan and sections showing relationship to equipment.
2. Mechanical and process equipment:
 - a. Operating characteristics:
 - 1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
 - 2) Brake horsepower requirements.
 - 3) Copies of equipment data plates.
 - b. Piping and duct connection size, type and location.
 - c. Equipment bearing life certification.
 - d. Equipment foundation data:
 - 1) Equipment center of gravity.
 - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
 - 3) Type, size, and materials of construction of anchorage.
 - 4) Data required by Section 03 15 19 - Anchorage to Concrete for anchor rod design.
3. Electric motor:
 - a. Motor manufacturer and model number.
 - b. Complete motor nameplate data.
 - c. Weight.
 - d. NEMA design type.
 - e. Enclosure type.
 - f. Frame size.
 - g. Winding insulation class and temperature rise.
 - h. Starts per hour.
 - i. Performance data:
 - 1) Motor speed-torque curve superimposed over driven machine speed-torque curve during start-up acceleration and at rated terminal voltage a minimum permissible or specified terminal voltage for all motors over 5 HP.

- 2) Time-current plots with acceleration versus current and thermal damage curves at the operating and ambient temperatures and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 5 HP.
 - 3) Guaranteed minimum efficiencies at 100 percent, 75 percent, and 50 percent of full load.
 - 4) Guaranteed minimum power factor at 100 percent, 75 percent, and 50 percent of full load.
 - 5) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
 - 6) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
 - j. Bearing data and lubrication system.
 - k. Natural frequency calculations for:
 - 1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
 - 2) Individual piece of rotating equipment.
 - 3) Equipment driver and connected gear reducer, if applicable.
 - l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.
 - m. Fabrication and/or layout drawings:
 - 1) Dimensioned outlined drawing.
 - 2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
 - n. Certifications:
 - 1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
 - 2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
 - a) Include minimum speed at which the motor may be operated for the driven machinery.
 - o. Electrical gear:
 - 1) Unless specified in a narrow-scope Specification Section, provide the following:
 - a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
 - 2) Control panels:
 - a) Panel construction.
 - b) Point-to-point ladder diagrams.
 - c) Scaled panel face and subpanel layout.
 - d) Technical product data on panel components.
 - e) Panel and subpanel dimensions and weights.
 - f) Panel access openings.
 - g) Nameplate schedule.
 - h) Panel anchorage.
 - i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70.
Include any required calculations.
4. Systems schematics and data:
 - a. Provide system schematics where required in system specifications.
 - 1) Acknowledge all system components being supplied as part of the system.
 - 2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
 - 3) Provide technical data for each system component showing compliance with the Contract Document requirements.
 - 4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
 5. For factory painted equipment, provide paint submittals in accordance with Section 09 96 00 - High Performance Industrial Coatings.

6. Qualifications for:
 - a. Natural frequency analysis firm and personnel.
 - b. Vibration testing firm and personnel.
 - c. Infrared thermography testing firm and personnel.
 - d. Electrical equipment and connections testing firm and personnel.
 7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification Section:
 - a. Natural frequency analysis and calculations.
 - b. Vibration testing.
 - c. Thermography testing.
 - d. Electrical equipment and connection testing.
- B. Factory Test Reports:
1. Natural frequency bump test reports where required for rotating equipment.
 - a. Minimum characteristics of impact hammer.
 - 1) Frequency Range 1 kHz.
 - 2) Range (5v output) 5,000 pounds-force (22,200 N).
 - 3) Hammer Sensitivity (7pprox.) 1 mV/lbf (0.23 mV/N).
 - 4) Resonant Frequency 12 kHz
 2. Motor, equipment and final assembled equipment including motor.
 - a. Determine natural frequency of assembled motor prior to shipping to equipment manufacturer or job site.
 - 1) Individual motor fastened to an “infinitely rigid” mass at the same bolt circle as the final assembled equipment.
 - b. Determine natural frequency of the pump.
 - 1) Pump fastened to an “infinitely rigid” mass at the same bolt circle as the final assembled equipment.
 - c. Determine natural frequency of the pump/motor assembly.
 - 1) Pump/motor assembly fastened to an “infinitely rigid” mass at the same bolt circle as the final field assembled equipment.
 - d. For this use, the "infinitely rigid" mass shall be at least 10 times the weight of the equipment being tested.
 3. Submit natural frequency report(s) for approval prior to shipment.
 4. Equipment performance tests.
 - a. As listed in individual equipment specifications.
- C. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
1. Notification, at least one week in advance, that testing will be conducted at factory.
 2. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
 3. Submit sample Manufacturer's Field Service Report (MFSR). Report shall use manufacturer's standard report or use the form in the Exhibits and have at least the following information:
 - a. 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.
 - b. 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.
 - c. Motor test reports.

- d. Field noise testing reports if such testing is specified.
 - e. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
 - f. Provide three bound final written reports documenting natural frequency testing, vibration monitoring and testing for specified equipment.
 - 1) Include the acceptance criteria of all equipment tested.
 - 2) Provide individual tabbed sections for information associated with each piece of tested equipment.
 - g. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
 - h. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
 - i. Certification that driven equipment and VFD are compatible.
4. Submit completed Manufacturer's Field Service Report (MFSR) for each piece of equipment supplied.
- E. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Motors:
 - a. ABB Baldor-Reliance.
 - b. General Electric.
 - c. Hyundai Heavy Industries.
 - d. Marathon Electric.
 - e. Siemens.
 - f. TECO-Westinghouse.
 - g. Toshiba U.S.
 - h. U.S. Motors, Nidec Motor Corporation.
 - i. WEG.
 - 2. Mechanical variable speed drives:
 - a. Reeves.
 - b. U.S. Motors (VariDrive).

2.2 MANUFACTURED UNITS

- A. Electric Motors:
- 1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
 - 2. Design for frequent starting duty equivalent to duty service required by driven equipment.
 - 3. Design for full voltage starting.
 - 4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
 - 5. Size for altitude of Project.
 - 6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
 - 7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
 - 8. AC electric motors less than 1/3 hp:
 - a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.

- c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
 - 9. AC electric motors 1/3 to 1 hp:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - 1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
 - 10. AC electric motors 1-1/2 to 10 hp:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
 - 11. AC electric motors greater than 10 hp:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
 - 1) Design bearing life for 90 percent survival rating at 50,000 hours of operation for motors up to and including 100 hp.
 - 2) For motors greater than 100 hp, design bearing life for 90 percent survival rating at 100,000 HRS of operation.
 - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
 - d. Thermal protection:
 - 1) For motors 50 hp and above controlled from a variable frequency drive and for all other motors 100 hp and above, provide one of the following:
 - a) Integral thermal detectors (thermostat) per phase with normally closed contacts wired in series that will open on overtemperature
 - b) Resistance type temperature detector (RTD) complete with monitor and alarm panel having a normally closed contact that will open on overtemperature.
 - (1) Two thermal sensing devices per phase in each phase hot-spot location.
 - (2) Monitor and alarm panel:
 - (a) For constant speed motors, install panel in and energize from the motor starter equipment.
 - (b) For variable speed motors, install panel in and energize from the variable speed drive equipment.
 - 12. Severe duty motor to have the following minimum features:
 - a. All cast iron construction.
 - b. Gasketed conduit box.
 - c. Epoxy finish for corrosion protection.
 - d. Hydrosopic varnish on windings for corrosion protection.
 - e. Drain plug and breather.
- B. NEMA Design Squirrel Cage Induction Motors:
- 1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
 - 2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
 - 3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
 - 4. For use on variable frequency type adjustable speed drives, provide:
 - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
 - b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
 - c. Insulated drive end bearing on all motors.
 - d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 hp and larger.
 - e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 hp and larger.

- f. Shaft grounding ring on all motors:
 - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
 - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
- g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor.
 - 1) Variable torque: 10:1.
 - 2) Constant torque: 6:1.
- 5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 degrees C ambient.
- 6. Design motors for continuous duty.
- 7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent greater than the maximum HP requirements of the driven equipment over its entire operating range.
 - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
- 8. Motor enclosure and winding insulation application:
 - a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	TEFC, Standard Insulation
Wet indoor Areas	TEFC, Encapsulated Windings
Wet outdoor Areas	TEFC Encapsulated Windings
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, Encapsulated Windings

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

- 9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
- 10. Balance motors to ISO G2.5 level.
 - a. Submit prior to shipping to equipment manufacturer or job site.
- C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- D. V-Belt Drive:
 - 1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
 - 2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
 - 3. Provide staticproof belts.
- E. Mechanical Variable Speed Drives:
 - 1. Oil-lubricated shaft-mounted reduction gear drive capable of 300 percent shock load and providing a 1.5 service factor in accordance with AGMA.
 - 2. Assure infinite speed adjustment over a :1 range.
 - 3. Secure drive to equipment base.
 - 4. Flexible coupling between drive shaft and equipment shaft.
- F. Vibration Isolators:

1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.
- G. Space Heaters:
1. Silicone rubber strip type, 120 V rated.
 2. Provided on:
 - a. All motors 10 hp and larger mounted outdoors.
 - b. Indoor motors in humid environments as indicated.

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 hour 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 AGMA.
 5. Gear reducers:
 - a. Provide gear reducer totally enclosed and oil lubricated.
 - b. Utilize antifriction bearings throughout.
 - c. Provide worm gear reducers having a service factor of at least 1.20.
 - d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.4 ACCESSORIES

- A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
 2. Interior applications:
 - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
 - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 inches 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. Adhesive anchors per Section 03 15 19.
 - b. Epoxy grout per Section 03 31 30.
 - c. Threaded rods same as cast-in-place.
- C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
 2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

- D. Lifting Eye Bolts or Lugs:
 1. Provide on all equipment 50 pounds or greater.
 2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.
- E. Platforms and Ladders:
 1. Design and fabricate in accordance with OSHA Standards.
 2. Fabricate components from stainless steel grade 316.
 3. Provide platform surface: Non-skid checkered plate, unless specified in narrow-scope Specification Sections.

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 requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
 1. 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.
 1. Provide drain connection for 3/4 inches 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 cannot be properly prepared and painted.
 1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
 2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 07 92 00.
- I. Natural frequency/critical Speed:
 1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
 2. Excessive vibration is sufficient cause for equipment rejection.
 3. Ratio of all rotative speeds to natural frequency/critical speed of a unit or components: Greater than 1.2.
- J. Equipment Base
 1. Adequate grout and vent openings to allow grout to flow under entire base.
- K. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
 1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
 2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
 3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.

- a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
- 4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - a. Determine the SCCR rating by one of the following methods:
 - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
 - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

2.6 SHOP OR FACTORY PAINT FINISHES

- A. Electrical Equipment:
 - 1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Section 09 96 00 to receive field painting.
 - a. Field painted equipment: See Section 09 96 00 for factory applied primer/field paint compatibility requirements.
- B. Field paint other equipment in accordance with Section 09 96 00.
 - 1. See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

2.7 SOURCE QUALITY CONTROL

- A. Motor Tests:
 - 1. Test motors in accordance with NEMA and IEEE standards.
 - 2. Provide routine test for all motors.
 - 3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
 - a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
 - b. Pay all costs, including shipping and handling, for all motors failing the tests.
 - c. If two successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.
- B. Balance:
 - 1. Unless specified otherwise, for all equipment 10 hp or greater, all rotating elements in motors, pumps, blowers, and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. Balance all rotating elements to the following criteria, per ISO 21940-11:

$$U_{per} = \frac{G \times 6.015 \times W/2}{N}$$

Where:

- U_{per} = Permissible residual unbalance for each correction plane in ounce-inches (OZ-IN). See ISO 21940-11 for acceptable values.
- G = ISO Balance Quality Grade Number, per ISO 21940-11
- W = Rotor weight in pounds
- N = Maximum continuous operating RPM

- a. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment as shown on the Drawings and other Contract Documents, in accordance with manufacturer's written instructions, and in accordance with Laws and Regulations. Where the Contract Documents, manufacturer's written instructions, or Laws and Regulations conflict, obtain interpretation or clarification from Engineer before proceeding.
- B. Utilize appropriate templates for anchorage placement for equipment installed on concrete.
- C. Equipment Drainage Discharges:
 - 1. For equipment having drainage requirements, such as seal water, provide 3/4-inch copper, PVC, or clear plastic tubing from drainage discharge at equipment base to nearest floor drain or equipment drain. Do not discharge liquid across floors.
 - 2. Furnish and install bell up at each equipment base.
 - 3. Route equipment drainage piping clear of major traffic areas, to discharge to locations approved by Engineer. To extent practical, avoid creating tripping hazards.
- D. Coordination of Equipment Supports and Bases with Structures:
 - 1. Do not construct foundations until major equipment supports are approved by Engineer.
- E. Equipment Lubrication Points:
 - 1. Extend all non-accessible or difficult-to-access lubrication fittings to reasonably accessible locations to facility operation and maintenance personnel without use of ladders or elevating devices, by providing stainless steel tubing (of appropriate wall thickness for the service and application) to a location which allows easy access of fittings from closest operating floor level.
- F. Concrete Equipment Support Bases:
 - 1. Install level in both directions, with acceptable vertical tolerance of 1/4-inch±.
 - 2. At anchorage locations, install bases flat and level.
- G. Machine Bases / Sole Plates:
 - 1. Grease or tape anchorages and jack screws to inhibit grout from adhering to bolts and other anchors.
 - a. Jack screws number and size by equipment manufacturer.
 - 1) Jack screw
 - a) 304 Stainless Steel minimum
 - b) 0.5 inches diameter minimum
 - 2) Jack Screw Pad
 - a) 2 inch diameter minimum
 - b) Anchored in place with a structural epoxy adhesive.
 - 2. Install machine base of rotating equipment on equipment base.
 - 3. Level in both directions using jack screws, with a machinist level, according to machined surfaces on base. Base shall be level within vertical tolerance of the lesser of (a) 0.005 inch per foot with no more than 0.0005 inches difference between any two points, or (b) equipment manufacturer's written instructions.
 - 4. Level machine base on equipment base and align couplings between driver and driven equipment.
- H. Couplings for Rotating Equipment:
 - 1. Align in annular and parallel positions.
 - a. For equipment rotating at 1,200 rpm or less, align both annular and parallel within 0.001 inch tolerance for couplings four-inch size and smaller.
 - b. Couplings larger than four-inch size: Increase tolerance 0.0005 inch per inch of coupling diameter above four-inch; for example: for six-inch coupling, tolerance is 0.002 inch. For 10 inch coupling, required tolerance is 0.004 inch.

- c. For equipment rotating at speeds greater than 1,200 rpm, tolerance for both annular and parallel positions shall be rate of 0.00025 inch (or less) per inch of coupling diameter.
 - 2. If equipment is furnished by manufacturer as mounted unit , verify factory alignment after installation at the Site. Realign if as necessary, in accordance with equipment manufacturers' written instructions, to provide required factory tolerance.
 - 3. Inspect surfaces for runout before attempting to trim or align units.
- I. Grouting:
 - 1. Level onto equipment base with jack screws in accordance with the Contract Documents, provide a dam or formwork around base to contain grout between equipment base and equipment support pad.
 - 2. Preparation:
 - a. Extend dam or formwork to cover leveling shims and blocks.
 - b. Anchor sleeves:
 - 1) Required for equipment (Pumps, Mixers, Blowers) greater than 50 hp.
 - 2) If anchor sleeves were used, fill voids in anchor sleeves with foam or room temperature vulcanizing (RTV) silicone to keep grout from filling sleeves.
 - c. Do not use nuts below the machine base to level the unit.
 - d. Saturate top of roughened concrete surface with water before grouting.
 - 3. Grout Installation:
 - a. Install grout until entire space under machine base is completely filled to underside of base. Voids are unacceptable.
 - b. Puddle grout by working a stiff wire through the grout and vent holes, to ensure grout is installed properly and to release air entrained in grout or base cavity.
 - 4. After Grout Installation:
 - a. When grout is sufficiently hardened, remove dam or formwork and finish exposed grout surface to fine, smooth surface.
 - b. Completely cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too-rapid evaporation of water from grout.
 - c. Check for voids by tapping along the top deck of the mounting plate. A solid thud indicates grout-filled areas while a drum-like hollow sound indicates a void requiring filling.
 - 1) Void areas are to be filled by drilling 1/8 inches CH NPT holes in opposite corners of each void area. Grout to be pumped into one void with a grout gun until grout emerges from the other vent hole.
 - d. When grout is fully hardened (after not less than seven days), remove jack screws, and tighten nuts on anchor bolts and similar anchors to required torque.
 - e. Inspect and verify levelness of machine base and, if not in accordance with requirements, remedy by removing base and reinstalling in accordance with the Contract Documents.
 - f. Inspect driver-driven equipment for proper alignment. When not in accordance with requirements, remedy so that the Work is not defective.

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.
 - 1. 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.

- a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
 - 1. All or any time expended during installation check does not qualify as Operation and Maintenance 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 10 14 00 - Identification Devices and 10 14 23 - Signage.
 - 1. All tagged equipment, valves, instruments, and other relevant appurtenances as indicated in Drawings shall include proper identification.

3.4 FIELD PAINTING AND PROTECTIVE COATINGS

- A. For required field painting and protective coatings, comply with Section 09 96 00 - High Performance Industrial Coatings.

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 stripped ends of conductors and associated connectors with electrical tape.
 - 1. Wrapping thickness shall be 150 percent of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

3.6 FIELD QUALITY CONTROL

- A. General:
 - 1. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
 - 2. Execute pre-demonstration requirements in accordance with Section 01 75 00.
 - 3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
 - 4. Provide testing for all equipment furnished or installed as part of the Work.
 - 5. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptable standards.
 - 6. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
 - a. Contract Drawings and Specifications.
 - b. Related construction change documentation.
 - c. Approved Shop Drawings.
 - d. Approved Operation and Maintenance Manuals.
 - e. Other pertinent information as required.
- B. Equipment Monitoring and Testing Plans:
 - 1. Approved in accordance with Shop Drawing submittal schedule.
 - 2. Included as a minimum:
 - a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
 - b. List and description of testing and analysis equipment to be utilized.
 - c. List of all equipment to be testing, including:
 - 1) Name and tag numbers identified in the Contract Documents.
 - 2) Manufacturer's serial numbers.
 - 3) Other pertinent manufacturer identification,

- C. Instruments Used in Equipment and Connections Quality Control Testing:
 - 1. Minimum calibration frequency:
 - a. Field analog instruments: Not more than 6 months.
 - b. Field digital instruments: Not more than 12 months.
 - c. Laboratory instruments: Not more than 12 months.
 - d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
 - 2. Carry current calibration status and labels on all testing instruments.
 - 3. See individual testing programs for additional instrumentation compliance requirements.
- D. Testing and Monitoring Program Documentation:
 - 1. Provide reports with tabbed sections for each piece of equipment tested.
 - 2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
 - a. Include legible copies of all forms used to record field test information.
 - 3. Prior to start of testing, submit one copy of preliminary report format for Engineer review and comment.
 - a. Include data gathering and sample test report forms that will be utilized.
 - 4. In the final report, include as a minimum, the following information for all equipment tested:
 - a. Equipment identification, including:
 - 1) Name and tag numbers identified in the Contract Documents.
 - 2) Manufacturer's serial numbers.
 - 3) Other pertinent manufacturer identification,
 - b. Date and time of each test.
 - c. Ambient conditions including temperature, humidity, and precipitation.
 - d. Visual inspection report.
 - e. Description of test and referenced standards, if any, followed while conducting tests.
 - f. Results of initial and all retesting.
 - g. Acceptance criteria.
 - h. "As found" and "as left" conditions.
 - i. Corrective action, if required, taken to meet acceptance.
 - j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
 - k. Instrument calibration dates of all instruments used in testing.
 - 5. Provide three (3) bound final reports prior to Project final completion.
- E. Electrical Equipment and Connections Testing Program:
 - 1. Perform testing on Electrical equipment, connections, and motors in accordance with 26 05 00 – General Requirements for Electrical Work .
- F. Other Testing:
 - 1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
 - 2. 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 members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
 - a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.
- G. Infrared Thermography Testing Program:
 - 1. Perform infrared thermography testing for equipment specified in other Divisions during the Equipment Demonstration Period.
 - a. Perform on all rotating and reciprocating equipment having drivers 25 hp or greater.
 - 2. Additional requirements for infrared thermography monitoring and testing equipment:
 - a. Temperature range: -10 to 350 degrees C.
 - b. Accuracy: ± 2 percent or 2 degrees C, whichever is greater.

- c. Repeatability: ± 1 percent or 1 degree C, whichever is greater.
 - d. Temperature indication resolution: 0.1 degrees C.
 - e. Minimum focus distance: 0.3 meters.
 - f. Output in color palettes: JPEG, BMP, or other digital format compatible with Windows.
3. Perform inspection per ASTM E1934.
 - a. Operate VFD driven equipment at 100 percent speed during thermographic inspection.
 4. Acceptability of electrical connections and components based on temperature comparison between components and ambient air temperatures not greater than 10 degrees C per ASTM E1934.
 5. Acceptability of motors and equipment bearings based on temperature rise not greater than 5 DEGC above the equipment and/or bearing manufacturers published criteria.
- H. Equipment Field Vibration Monitoring and Testing Program:
1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.
 2. Perform field vibration testing on each item of rotating and reciprocating equipment having driver 50 HP and greater
 3. Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G6.3 criteria.
 4. Acceptability of pumping equipment to be based on current ANSI/HI criteria:
 - a. ANSI/HI 11.6-2022 for Submersible Pumps in a Wet-pit or Dry-pit configuration.
 - b. ANSI/HI 9.6.4-2022 for all other centrifugal pumps.
 5. Utilize an Engineer approved 3rd party testing agency to perform vibration monitoring and testing on equipment.
 6. For variable speed equipment provide vibration testing at no more than 3 percent increments of maximum speed throughout entire operating range.
 7. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency.
 8. Tolerances for pumping equipment shall be per HI published standards.
 9. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
 10. Document testing with written report.
 - a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.
 - b. Natural frequency of installed equipment utilizing an impact hammer.
 - c. Report to include graphical plots of vibration signature for each test point at a scale which illustrates all vibration levels greater than 0.025 ips RMS.

3.7 DEMONSTRATION

- A. Demonstrate equipment in accordance with Section 01 75 00.

3.8 ABBREVIATION TABLE

- A. As indicated on the Drawings.

3.9 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

EXHIBIT A
MANUFACTURER FIELD SERVICE REPORT

This field service report is generic in nature. An electronic copy of this form will be furnished upon request from the Engineer. This report is to reflect that all requirements of the Operations and Maintenance Manual and the individual equipment specification requirements have been performed for the installation and operation and also to provide a baseline for amperage draw for each phase, vibration readings, rotation, alignment and all other applicable tests required to ensure that the equipment has been installed properly. A MFSR will be required for each individual piece of equipment requiring a MFSR.

Definitions of Reports:

Initial service report: Required for construction preparations. Equipment delivered to site is in good condition and conforms to specification requirements. Anchor bolts, hardware and ancillary items (piping, flanges, conduits, fuel/power supply) are compatible with equipment.

Interim service report: Required for equipment installation onto base or foundation. Piping connections, electrical and control connections or structural attachment are complete. For equipment stored on site over four weeks, interim service report will document that manufacturer's long-term storage procedures have been incorporated and equipment has not been damaged, nor coatings deteriorated.

Final service report is to be completed when equipment can be started, electrical amperage and voltage draw measured, cold and hot alignments performed, vibration testing and monitoring performed and the equipment is found to be in compliance with Manufacturer's operating parameters and the requirements of the individual equipment specifications.

PROJECT: Ketchum / SVWSD WRF Aeration Upgrades

Report Status:

Initial Service Report completed and submitted on _____

Interim Service Report completed and submitted on _____

Final Service Report completed and submitted on _____

Commencement of Warranty _____

I Description

A. Equipment Name and Identification: _____

B. Serial Number: _____

C. Specification Section Number: _____

D. Manufacturer: _____

E. Representative: _____

F. Type of Service: Initial [_____] Interim [_____] Final [_____]

II General Review

A. The above referenced equipment/material/supplies have been inspected, checked, and adjusted. Yes [_____] No [_____]

Summary: _____

B. The above referenced equipment/material/supplies were placed upon properly prepared or suitable substrate. N/A [_____] Yes [_____] No [_____]

Summary: _____

C. The above referenced equipment/material/supplies are free from any undue stress imposed by any connected piping, anchor bolts or any other load. N/A [_____] Yes [_____] No [_____]

Summary: _____

D. The above referenced equipment/material/supplies have operated under design conditions.
 N/A [_____] Yes [_____] No [_____]

Summary: _____

E. The above referenced equipment/material/supplies have been installed in accordance with the manufacturer's recommendations and the Procurement Documents, require no corrective work, and are hereby approved. Yes [_____] No [_____]

Summary: _____

F. The above referenced equipment/material/supplies are acceptable to the manufacturer as installed providing the following corrective action(s) are performed:

1. _____

2. _____

3. _____

4. _____

5. _____

III Inspection Checklist

Item	Acceptable (Yes/No)	Readings/Comments
Bearings (1)		
Belts (tension reading)		
Lubrication Levels		
Vibration (1) (2) (MILS/SEC)		
Infrared Thermography (1) (2)		
Starting AMPS		
Full Load AMPS		
Volts		
Rotation		
Jacket Temperature (DEGF)		
Seal Water Flow Rate (GPH or GPM)		
Seal Water Pressure (PSI)		
O-rings/Packing		
Alignment (1)		
Anchor Bolts		

Item	Acceptable (Yes/No)	Readings/Comments
Anchor Bolt Torque		
Grout		
Substrate Approval		
Sound level (4 feet from unit) (1) (dB)		
Other		

(1) Inspection or testing reports must be attached.
(2) Provide vibration testing and monitoring procedures for Engineer's review and approval prior to testing.

IV O&M Manuals

- A. The O&M manual as presented contains all information required for proper operation, maintenance, and instruction of this system. N/A [] Yes [] No []

Summary: _____

V Preventive Maintenance

- A. The preventive maintenance summary outlined in the O&M manual is acceptable for operation of the system throughout the warranty period. N/A [] Yes [] No []

Summary: _____

VI Operator Training/Classroom Instruction

- A. Training and instruction have been performed in accordance with the requirements of the Procurement Documents. N/A [] Yes [] No []

B. Final Training/Classroom Instruction Completed on: _____

Summary: _____

VII Remarks

VIII Certification

I hereby certify, that I, [____], am a duly authorized representative of the manufacturer, that I am empowered by the manufacturer to inspect, approve, and operate his equipment, and that I am authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as modified herein. I also certify that all information contained herein is true and accurate.

By: _____
(Authorized Representative)

For: _____

Date: _____

IX Acknowledgments

By: _____

For: _____
(Contractor)

Date: _____

By: _____

For: _____
(Engineer)

Date: _____

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SECTION 01 64 00
OWNER-FURNISHED PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements and procedures for Owner-furnished materials and equipment to be installed by Contractor, including:
 - a. Items in Owner's existing stock to be installed or relocated by Contractor.
 - b. Items purchased by Owner under one or more separate procurement contracts.
 - c. Handling and storage of Owner-furnished items.
- B. Scope:
1. Contractor shall provide labor, materials, tools, equipment, services, and incidentals shown, specified, and necessary for accepting, handling, insuring, storing, and maintaining as required, installing, checking out, starting-up, and completing Owner-furnished materials and equipment in accordance with the Contract Documents.

1.2 OWNER FURNISHED MATERIALS AND EQUIPMENT

- A. Items of equipment and materials to be furnished by Owner for installation by Contractor are indicated below.
1. Furnished under one or more procurement contracts separately entered into by Owner (as "buyer") with a seller:
 - a. Installed by Contractor: new variable frequency drives (VFD) for the three (3) existing RAS pumps, one (1) existing WAS pump, four (4) new MLR pumps, and two (2) new blowers. Award of contract for VFD purchase is planned for December 2023; delivery timing anticipated to be between 3 – 12 months, depending on availability. Items will be delivered FOB to the Site.
 2. Materials and equipment currently in Owner's stock or possession to be installed or relocated by Contractor:
 - a. Installed by Contractor: B-302 and B-303, currently located in the Admin Building Garage at the Ketchum / SVWSD WRF. Install at the location shown on the Drawings.
- B. Availability of Owner-Furnished Materials and Equipment:
1. Owner-furnished materials and equipment will be available to Contractor starting on:
 - a. Items Obtained via Procurement Contracts: On the date(s) or time(s) indicated for delivery as set forth in the associated procurement contract.
 - b. Existing Items Already in Owner's Possession: Available on the date the Contract Times start to run and as necessary thereafter to maintain the Progress Schedule accepted by Engineer.
- C. Availability of Procurement Contract Documents:
1. When Procurement Contract is Assigned: A copy of the procurement contract documents is part of the construction Contract Documents, as an exhibit to the Agreement, as indicated in the enumeration of the Contract Documents in the Agreement.
 2. Procurement Contract is not Assigned: An electronic copy of the procurement contract documents was distributed with the construction Bidding Documents. Should such copy not be available to Contractor, an electronic copy, in portable document format (PDF), of the procurement contract documents is available from Engineer upon request. Contractor is responsible for printing and binding paper copies of the procurement contract documents needed by Contractor.

- D. For Owner-furnished materials and equipment obtained via one or more procurement contracts that are not assigned to Contractor, Engineer will keep Contractor informed of probable delivery dates of the materials and equipment included in the procurement contract.
- E. Owner's Responsibilities:
1. Within 10 days after the Effective Date of the Contract, Owner will arrange for and deliver to Contractor an electronic copy (in portable document format; PDF) of each of seller's shop drawings, samples (except for physical samples, of which one each will be delivered to Contractor), and other submittals as reviewed by Engineer or Owner. Such submittals, whether approved or otherwise, are not part of the Contract Documents.
 2. Electronic copy of seller's shop drawings and other submittals, furnished to and approved or accepted by Engineer or Owner, were issued with the Bidding Documents; however, seller's submittals are neither part of the Bidding Documents nor part of the proposed Contract Documents.
 3. When Procurement Contract is Not Assigned to Contractor: Owner (or Engineer, on behalf of Owner) will advise Contractor of the anticipated delivery date 10 days prior to scheduled delivery. Upon telephone advisory from seller's shipping entity/carrier, Owner (or Engineer, on behalf of Owner) will give Contractor approximately 24 hours' advance notification, by telephone, of scheduled delivery.
 4. Owner shall arrange and pay for delivery to the Site of Owner-furnished materials and equipment obtained via procurement contracts.
 5. When procurement contract is not assigned to Contractor, upon delivery, Owner (who may be accompanied by Engineer, at Owner's option) shall inspect, jointly with Contractor, the materials and equipment delivered by seller. Where appropriate, Owner will arrange with seller to have seller's representative present at the delivery point to assist in visually inspecting the delivered materials and equipment.
 6. When procurement contract is not assigned to Contractor, the Owner will submit to seller claims for damage incurred in transit to the delivery location and shall replace damaged, defective, or nonconforming items of Owner-furnished materials and equipment obtained via procurement contract.
 7. When procurement contract is not assigned to Contractor, the Owner shall pay for services of seller's factory-trained representative to furnish consultation and advice during installation of associated Owner-furnished materials and equipment, to inspect, check, and approve installation before operation, and to furnish technical advice and direction during start-up and field quality control activities for Owner-furnished materials and equipment. Extent to which services of seller's representative will be provided during installation will be in accordance with the procurement contract documents.
 8. If services of seller's representative beyond the scope of such services set forth in the procurement contract document is desired by Contractor, or if such services are necessary as a result of defective Work by Contractor, Contractor shall arrange and pay for such services of seller's representative.
 9. After Substantial Completion, Owner (or facility manager, if other than Owner) will operate and maintain the items obtained via procurement contract and coordinate directly with seller regarding matters of routine maintenance. When associated procurement contract is not assigned to Contractor, the Owner (or facility manager, if other than Owner) will communicate directly with seller regarding warranty-related matters. When procurement contract is assigned to Contractor, the Owner (or facility manager, if other than Owner) will communicate warranty-related issues to Contractor.
- F. Contractor's Responsibilities:
1. When procurement contract is assigned to Contractor, the Contractor has all of Contractor's responsibilities under the Contract Documents plus all of buyer's responsibilities under the procurement contract documents, from the time the assignment is effective. Under the assigned procurement contract, Contractor is responsible to Owner to same extent that seller is responsible to buyer under the terms and conditions of the associated procurement contract.

2. When procurement contract is not assigned to Contractor, the Contractor's responsibilities for Owner-furnished materials and equipment delivered by seller begin upon Contractor's commencing to unload and handle Owner-furnished materials and equipment at the delivery location.
3. Receive and unload at the Site the Owner-furnished materials and equipment. Provide all labor, materials, equipment, tools, services, and incidentals for unloading. Perform unloading promptly upon each delivery vehicle's arrival at the Site. Pay all charges for demurrage due to negligence or delay by Contractor.
4. Promptly upon Contractor taking custody, visually inspect Owner-furnished materials and equipment for completeness and damage.
 - a. When procurement contract is not assigned to Contractor and when Owner-furnished items are already in Owner's possession (as existing stock or inventory), visual inspection will be jointly with Owner (and others, if any, invited by Owner).
 - b. Regardless of whether procurement contract is assigned to Contractor or whether Owner-furnished items are from Owner's existing stock or inventory, promptly after visual inspection (but in no event later than two days), prepare and furnish to Owner (with copy to Engineer) list of missing, damaged, or nonconforming goods.
 - c. When procurement contract is assigned to Contractor, reject damaged, defective, or nonconforming items and obtain conforming items from the seller. Owner reserves the right to accept Owner-furnished items rejected by Contractor and to authorize their use in the Work.
5. Indicate to Owner (with copy to Engineer) signed acceptance of delivery on copy of shipping documents furnished by seller's carrier. When procurement contract is assigned to Contractor, also give seller notice required by the procurement contract, following visual inspection upon delivery.
6. Builder's Risk Insurance Coverage:
 - a. Where builder's risk insurance for the Work is furnished by Contractor and the procurement contract is not assigned to Contractor, increase the amount of builder's risk insurance to be not less than the Contract Price plus the replacement value of Owner-furnished materials and equipment as indicated in the builder's risk insurance requirements in the Supplementary Conditions.
 - b. Where builder's risk insurance for the Work is furnished by Contractor and the procurement contract is assigned to Contractor, amount of builder's risk insurance coverage shall be not less than the entire Contract Price (including both construction plus the amount of the assigned procurement contracts), in accordance with the builder's risk insurance provisions of the General Conditions and Supplementary Conditions.
 - c. Furnish to Owner copies of evidence of such revised builder's risk insurance coverage.
7. Handle, store, protect, and maintain Owner-furnished materials and equipment, as indicated elsewhere in this Section.
8. Remedy of Damage Incurred While in Contractor's Custody:
 - a. For materials and equipment obtained via procurement contract, repair or replace Owner-furnished materials and equipment that are missing, lost, or damaged after receipt by Contractor. Replacements shall be in accordance with the associated Owner-prepared procurement contract documents.
 - b. For existing items already in Owner's inventory or possession at the start of the Work, remedy loss or damage to such items incurred during Contractor's custody. Rehabilitation or refurbishment of such items, when required by the Contract Documents, will be in accordance with the Contract Documents and paid under the Contract.
 - c. Contractor is not entitled to compensation for, or increase in Contract Price or Contract Times, for remedying damage or loss to Owner-furnished items incurred while in Contractor's custody.
9. Coordination with Submittals and Manufacturer Instructions:

- a. For Owner-furnished materials and equipment obtained via procurement contract, coordinate with seller's shop drawings, samples, and other submittals including seller's written handling and installation instructions, reviewed and approved (or accepted) by Owner or Engineer, as applicable.
 - b. For existing items in Owner's inventory or possession at the start of the Work that are to be handled or installed by Contractor, coordinate with Owner-furnished copies of shop drawings and other submittals (if available), operation and maintenance manuals (if available), as furnished to Contractor for such items. Obtain from item's manufacturer written instructions on handling and installation for the item and comply with such written instructions and the Contract Documents.
10. Install, connect, check out, and start up Owner-furnished materials and equipment in accordance with manufacturer's written instructions, unless otherwise shown or indicated in the Contract Documents.
 11. Perform field quality control activities for Owner-furnished items in accordance with the contract Documents. Where such items were obtained under one or more procurement contracts, Contractor shall coordinate with and cooperate with seller in performing field quality control activities.

1.3 ASSIGNED PROCUREMENT CONTRACTS

- A. Contracts for procurement of materials and equipment described in this paragraph are assigned to the Contract(s) designed below, in accordance with the Agreement and the Supplementary Conditions.
 1. Assigned to Contractor: As indicated in this Project Manual.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Review installation procedures for Owner-furnished materials and equipment and coordinate installation of items to be installed with or before Owner-furnished materials and equipment.
- B. Scheduling:
 1. Schedule and perform the Work to coordinate with anticipated delivery dates for Owner-furnished materials and equipment, as indicated in Owner's procurement contract(s) therefor.
 2. Where Owner will furnish services of a manufacturer's representative for Owner-furnished materials and equipment, schedule and perform the Work in accordance with scheduling constraints of manufacturer's representative.
 3. Comply with the Contract Time indicated in the Contract Documents, and Section 01 13 13 - Milestones.

1.5 HANDLING AND STORAGE

- A. Handling:
 1. Handle Owner-furnished materials and equipment in accordance with the Contract Documents and the item manufacturer's written instructions. Handle so that warranties in effect are not voided.
- B. Storage:
 1. Store Owner-furnished materials and equipment in accordance with the Contract Documents and the item manufacturer's instructions. Store so that warranties in effect are not voided.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 65 00
PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General requirements for:
 - a. Coordination of deliveries.
 - b. Preparing materials and equipment for shipping from the production or fabrication facility, including packaging.
 - c. Shipment.
 - d. Delivery of materials and equipment to the Site.
 - e. Inspection upon delivery and remedy of damaged, deteriorated, or otherwise defective items, and remedy of missing or lost items.
- B. Scope:
1. Contractor shall make all arrangements for packaging, shipping, delivering, inspecting upon delivery, and unloading upon delivery materials and equipment necessary and required for the Work.
 2. Contractor shall provide all labor, materials, equipment, tools, incidentals, and services necessary to have materials and equipment properly packaged, shipped, and delivered to the Site, and all related Work required by the Contract Documents.
- C. Related Requirements: Include but are not limited to:
1. Section 01 29 76 - Progress Payment Procedures.
 2. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.
 3. Section 01 66 00 - Product Storage and Handling Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. To extent practicable, coordinate shipping and delivery of materials and equipment with anticipated shipping requirements, such as allowing sufficient time for customs inspections on international shipments, availability of shipping services and facilities, and seasonal concerns (such as shipments that may be influenced by major tropical storms and predictable, typical weather).
 2. Coordinate shipping and delivery of materials and equipment to the Site and other locations where such items may be stored prior to delivery to the Site. Coordinate such shipments and deliveries with the progress of the Work and status of adequate facilities, whether temporary storage or permanent installation locations, necessary to properly store and safeguard materials and equipment to be incorporated into the Work.
 3. Where possible, deliver to the Site materials and equipment as close as possible to when such items will be incorporated into appropriately protected, permanent installation location.

1.3 PREPARATION FOR SHIPMENT

- A. Factory Assembly:
1. When practical, factory-assemble materials and equipment. Mark or tag separate parts and assemblies to facilitate field assembly.
- B. Temporary Protection:
1. Appropriately cover, with strippable, protective coating or other material, machined parts and unpainted, uncoated, or unprotected surfaces subject to damage or deterioration caused by weather elements or environment,

2. To extent practical, strippable, removable, disposable protective materials shall be recyclable.
 3. To extent practical, strippable, removable, and disposable protective items shall be type resulting in minimum waste and cleanup upon removal.
 4. Protection of Electrical Equipment, Instrumentation and Controls, Items with Computer Chips Solid-State Devices, and Other Electronics:
 - a. Provide appropriate temporary protection of electrical equipment, microprocessors, and other electronics from humidity, moisture, and corrosion by appropriate packaging, protection, desiccants, and volatile corrosion inhibitor (VCI) blocks.
 - b. Immediately prior to shipment, provide new, fresh desiccants and ensure integrity of other protective materials.
- C. Packaging:
1. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage.
 2. Mark, label, or tag, on outside of each package, crate, and container, to indicate associated:
 - a. Purchase order number.
 - b. Bill of lading number.
 - c. Delivery address (including facility name, where applicable).
 - d. Owner's contract designation or Project name.
 - e. Contractor name.
 - f. Purchasing Subcontractor's name (as applicable).
 - g. Contents by name and designation within the Work (for example, "Influent Pump No. 1"),
 - h. Approximate weight of container, crate, package, including packaging.
 - i. Special instructions for handling and protection during shipment and unloading.
 - j. Comply with Section 01 35 43.13 - Environmental Procedures for Hazardous Materials, when materials or equipment contain Constituents of Concern.
 3. The Site may be listed as the "ship to" or "delivery" address; but Owner or facility manager shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.
 4. Truthfully and accurately mark, label, or tag items for shipment and delivery.
 5. Include complete packing lists and bills of materials with each shipment.
 6. Protect materials and equipment with appropriate, temporary packaging or protection when such items may rotate or move during shipment.
 7. Protect materials and equipment from exposure to weather elements, adverse environments, and keep thoroughly dry and dust-free. Protect painted surfaces against impact, abrasion, discoloration, and other damage and deterioration.
 8. Lubricate bearings and other items requiring lubrication, in accordance with manufacturer's written instructions.

1.4 SHIPPING

- A. Notification of Shipments:
1. Keep Engineer and Owner informed of delivery of all materials and equipment to be incorporated into the Work.
- B. Do not ship materials and equipment until:
1. Related Shop Drawings, product data, Samples, shop testing plan Submittals, and other Submittals required by the Contract Documents are approved by Engineer, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
 2. Manufacturer's written instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer, in accordance with the Specifications.
 3. Results of source quality control activities (factory testing and inspections), when required by the Contract Documents for the subject materials or equipment, have been submitted to and accepted by Engineer.

4. Facilities required for handling materials and equipment, in accordance with the Contract Documents and manufacturer's instructions, are in place and available at the delivery location.
 5. Required storage facilities and protection measures have been provided.
- C. Loss or Damage During Shipment:
1. Unless otherwise indicated in the Contract Documents (whether expressly or in provisions regarding builder's risk insurance), Contractor is responsible for all loss, damage, and deterioration to materials and equipment incurred during shipment and delivery.
 2. Contractor is not eligible for additional Contract Times or increase in the Contract Price due to delays or costs incurred due to loss, damage, or deterioration during shipment, unless Owner was responsible for shipping the subject materials or equipment to the Site or other delivery location.

1.5 DELIVERY

- A. Scheduling and Timing of Deliveries:
1. Arrange deliveries of materials and equipment in accordance with the Progress Schedule accepted by Engineer and in ample time to facilitate inspection and observation prior to installation.
 2. Schedule deliveries to minimize space required for, and duration of, storage of materials and equipment at the Site or other delivery location, as applicable.
 3. Coordinate deliveries to avoid conflicting with the Work and conditions at the Site, and to accommodate the following:
 - a. Work of other contractors at or adjacent to the Site, Owner, and others.
 - b. Storage space limitations.
 - c. Availability of appropriate construction equipment and machinery, tools, and qualified personnel for inspecting, unloading, and handling materials and equipment.
 - d. Owner's use of premises.
 4. Deliver materials and equipment to the Site during regular working hours.
 5. Deliver materials and equipment to avoid delaying the Work and the Project.
- B. Deliveries:
1. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number to shipper or carrier.
 2. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner and Contractor shall be responsible for the associated delays and costs, including demurrage.
 3. Comply with Section 01 35 43.13 – Environmental Procedures for Hazardous Materials, as applicable.
- C. Containers and Marking:
1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
 2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.
- D. Inspection of Materials and Equipment Upon Delivery:
1. Immediately upon delivery, visually but critically inspect shipment to verify that:
 - a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) Submittals.
 - b. Quantities are correct.
 - c. Materials and equipment are undamaged and of required quality.
 - d. Containers and packages are intact and labels are complete and legible.
 2. Eligibility for Payment:

- a. Materials and equipment are not eligible for payment until duly inspected and determined to be in accordance with the Contract Documents and Engineer-approved Submittals, without damage or deterioration.
 - b. No payment can be made for damaged, deteriorated, or otherwise defective items.
 - c. No payment can be made for missing or lost items.
 - d. Other provisions of the Contract Documents may establish other preconditions for payment for delivered material and equipment, including Section 01 29 76 – Progress Payment Procedures.
3. Damaged, Deteriorated, and Otherwise Defective Items:
- a. Promptly remove from the Site damaged, deteriorated, or defective materials and equipment and expedite delivery of new, undamaged materials and equipment.
 - b. Promptly remedy incomplete or lost materials and equipment.
 - c. Furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
 - d. Promptly advise Engineer in writing: (1) when damaged, deteriorated, incomplete, or otherwise defective materials and equipment are delivered, and (2) associated impact on the Progress Schedule.
- E. Handling of Materials and Equipment Upon Delivery:
1. Provide construction equipment and machinery, tools, and qualified personnel necessary to unload and handle materials and equipment, including those furnished by Owner, by methods that prevent damaging, defacing, and soiling materials and equipment and packaging.
 2. Comply with Section 01 66 00 – Product Storage and Handling Requirements.
 3. Provide additional protection during unloading and handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and adjacent surfaces.
 4. Unload and handle materials and equipment by methods that prevent bending, warping, and overstressing.
 5. Lift heavy components only at designated lifting points.
 6. Unload and handle materials and equipment in safe manner and as recommended by manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during unloading and handling.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General requirements for:
 - a. Payment considerations for stored materials and equipment.
 - b. Handling of materials and equipment.
 - c. Storage of materials and equipment, including:
 - 1) General provisions for storage.
 - 2) Storage locations.
 - 3) Protection of stored items.
 - 4) Storage of items containing Constituents of Concern.
 - 5) Outdoor, uncovered storage.
 - 6) Outdoor, covered storage.
 - 7) Fully-protected storage.
 - 8) Removal of temporary storage facilities and restoration of storage areas.
 - d. Maintenance of storage.
- B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, services, lands, and incidentals necessary and required to store and handle materials and equipment to be incorporated into the Work, and other materials and equipment at the Site, adjacent areas, and offsite storage areas.
- C. Related Requirements: Include but are not limited to:
1. Section 01 29 76 - Progress Payment Procedures.
 2. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.
 3. Section 01 65 00 - Product Delivery Requirements.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Measurement and Payment:
1. Materials and equipment delivered but not suitably stored and protected will not be eligible for payment.
 2. Engineer may recommend reduction in payment, and Owner may reduce payments to Contractor (“set-offs”) by an appropriate amount when stored items are subsequently revealed to be improperly stored or protected.
 3. Payment for Suitably Stored Items:
 - a. Requirements for payment for materials and equipment delivered and suitably stored, but not yet incorporated into the Work, are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 29 76 - Progress Payment Procedures.
 - b. Materials and equipment delivered and suitably stored, but not yet incorporated into the Work, will not be eligible for payment until the inspection upon delivery, required in Section 01 65 00 - Product Delivery Requirements, is completed and Engineer concurs that such items generally appear to be in good condition, in accordance with the Contract Documents, and are of the required quality and quantity.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following:
1. Affidavits of Inspection and Maintenance Performed on Mechanical and Electrical Equipment in Long-Term Storage:

- a. Submit in accordance with requirements of Article 3.1 of this Section.
2. Other Records of Inspection and Maintenance of Stored Materials and Equipment:
 - a. Establish and maintain such records as required by this Section.
 - b. Submit to Engineer or Owner (as applicable) within three days of Contractor's receipt of such request.

1.4 HANDLING

- A. Handling of Materials and Equipment – General:
 1. Handle materials and equipment to be incorporated into the Work in accordance with the Contract Documents and manufacturer's written instructions.
 2. During handling and assembling of materials and equipment:
 - a. Maintain validity of manufacturers' warranties.
 - b. Comply with:
 - 1) Section 01 65 00 - Product Delivery Requirements.
 - c. Do not drop, drag (without appropriate rollers or skids), or scrape materials and equipment.
 - d. Use proper construction equipment and machinery, and tools, operated by sufficient number of qualified personnel.
 - e. Maintain materials and equipment in neutral position.
 - f. Do not exert undue stress on materials and equipment.
 - g. Do not deform, bend, or damage materials and equipment.
 - h. Do not deform or mar shafts, bearings, or other parts.
- B. Additional Requirements for Hoisting and Lifting:
 1. When lifting or hoisting, support materials and equipment from appropriate lifting points using proper hooks and suitable nylon lifting straps, chains, and cables. Do not mar or scrape surfaces of materials and equipment during handling.
 2. For work in existing facilities, comply with Section 01 14 19 - Use of Site, regarding use of Owner's existing hoisting equipment and elevators, as applicable.
 3. Do not support rigging from building or structure without written approval of Engineer.

1.5 STORAGE

- A. Storage – General:
 1. Contractor shall make all arrangements and provide all measures necessary and required for, and pay all costs associated with, storing materials and equipment.
 2. Store materials and equipment in accordance with the Contract Documents and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions regarding storage and protection, comply with the more-stringent, more-protective requirements.
 3. Records:
 - a. Establish and maintain up-to-date account of materials and equipment in storage, to facilitate preparation of progress payment requests, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.
 - b. Submit affidavits of inspection and maintenance of mechanical and electrical equipment in long-term storage in accordance with this Section's Article 3.1 ("Maintenance of Storage").
 4. Arrange stored materials and equipment to allow easy access for observation or inspection by Owner, Engineer, Owner's Site Representative (OSR), Owner-hired testing and inspection entities, and authorities having jurisdiction.
 5. Inspect and maintain stored materials and equipment in accordance with this Section's Article 3.1 ("Maintenance of Storage").
- B. Storage Location:

1. Area(s) available at the Site for storing materials and equipment are addressed in Section 01 14 19 - Use of Site.
 2. When onsite storage is insufficient, Contractor shall provide additional lands for storage facilities as necessary and required for the Work.
 3. Restrictions on Storage Locations:
 - a. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.
 - b. Do not use lawns, landscaped areas, or private property for storage without written permission of property owner.
 - c. Comply with:
 - 1) Section 01 14 19 - Use of Site.
- C. Protection of Stored Items – General:
1. Store materials and equipment indicated below to ensure preservation of quality and fitness for intended uses in the Work, including proper protection against damage and deterioration resulting from: water (including precipitation, flood, and other), moisture, humidity, wind, dust, freezing, and outdoor ambient air high temperature as high as 95 degrees F. Temperature and humidity inside crates, containers, storage structures, and packaging may be significantly higher than outdoor ambient air temperature.
 2. Store in indoor, climate-controlled storage all materials and equipment subject to damage or deterioration by water, moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner and Engineer.
 3. Do not open manufacturer’s crates, containers, and packaging until time of installation, unless recommended by the manufacturer or otherwise required in the Contract Documents.
 4. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
 5. Electrical Equipment, Instrumentation and Controls, Items Containing Computer Chips, Solid-State Devices, and Other Electronics:
 - a. Contractor shall obtain, coordinate, and comply with specific temperature, humidity, and environmental limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
 - b. Protect from water, moisture, humidity, dust, heat, cold, and other potentially harmful elements and environments. Space heaters provided in equipment shall be connected and operating at all times until equipment is connected to active, permanent, electrical power.
 - c. Provide inside each electrical panel, control panel, and other enclosures with electronic device(s) each of the following: (1) desiccant, (2) volatile corrosion inhibitor (VCI) blocks, (3) moisture indicator, and (4) maximum- and minimum-indicating thermometer.
 - d. Check panels and equipment not less than once per month. Replace desiccant, VCI, and moisture indicator the earlier of: (1) as often as necessary, or (2) every six months.
 - e. Establish and maintain certified record of daily maximum and minimum temperature and humidity in storage facility. Such records shall be available for Engineer’s and Owner’s inspection upon request. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be available to Engineer and Owner upon request.
 6. Finished Surfaces:
 - a. Protect finished surfaces against impact, abrasion, discoloration, and other damage.
 - b. Remedy, in accordance with requirements of item manufacturer and finishing system manufacturer damaged, marred, or deteriorated finishes, to Engineer’s satisfaction.
 7. Contractor is fully responsible for loss, damage, and deterioration, including theft and vandalism, to stored materials and equipment.
- D. Storage of Materials or Equipment Containing Constituents of Concern:
1. Prevent contamination of personnel, storage areas, the Site, and adjacent areas.

2. Comply with Laws and Regulations, Section 01 35 43.13 - Environmental Procedures for Hazardous Materials, and other provisions of the Contract Documents relative to Constituents of Concern and Hazardous Environmental Conditions.
- E. Uncovered Storage:
1. The following materials may be stored outdoors without cover on supports, so there is no contact with the ground:
 - a. Reinforcing steel.
 - b. Precast concrete materials.
 - c. Structural steel.
 - d. Grating.
 - e. Checker plate.
 - f. Metal access hatches, such as floor doors, roof hatches, and the like.
 - g. Castings.
 - h. Fiberglass items.
 - i. Rigid electrical conduit, except PVC-coated conduit.
 - j. Piping, except PVC or chlorinated PVC (CPVC) pipe.
- F. Covered Storage:
1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
 - a. Grout and mortar materials.
 - b. Masonry units.
 - c. Metal decking.
 - d. Rough lumber.
 - e. Soil materials and granular materials such as aggregate.
 - f. PVC and CPVC pipe.
 - g. PVC-coated electrical conduit.
 - h. Filter media.
 2. Properly and fully secure covers against coming loose in strong winds.
 3. Install coverings properly sloped to prevent accumulation of water.
 4. Loose Soil Material and Loose Granular Material:
 - a. Store such materials in well-drained areas.
 - b. Prevent mixing of such materials with foreign matter. Provide underlying separation layer or store on solid, impervious surface, where appropriate.
- G. Fully-Protected Storage:
1. Store all materials and equipment not indicated in the provisions above regarding uncovered storage and covered storage on supports, in buildings, trailers, or other suitable temporary storage facility with concrete or wood flooring, solid and impervious roof, and fully closed walls on all sides.
 2. Covering with visqueen plastic sheeting or similar material in storage space without floor, roof, and walls is unacceptable.
 3. Provide heated storage for materials and equipment that could be damaged or deteriorate by low temperatures or freezing.
 4. Provide air-conditioned storage for materials and equipment that could be damaged or deteriorate by high temperature or humidity.
 5. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
 6. Maintain temperature and humidity at levels recommended by materials and equipment manufacturers.
 7. Prevent infestation of stored items by pests and rodents. Promptly and properly remedy such infestation when apparent.
- H. Removal of Temporary Storage Facilities and Restoration of Storage Areas:
1. Completely remove temporary storage facilities when no longer necessary for the Work.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 MAINTENANCE OF STORAGE

- A. On a scheduled basis, periodically inspect stored materials and equipment to ensure that:
 - 1. Condition and status of storage facilities is adequate to provide required storage conditions.
 - 2. Required environmental conditions are maintained on continuing basis.
 - 3. Materials and equipment exposed to weather elements or other environment are not adversely affected.

- B. Mechanical and Electrical Equipment in Long-Term Storage:
 - 1. Meaning of the term “long-term storage” is as established in written instructions of manufacturer of associated materials or equipment.
 - 2. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer’s written instructions for servicing each item, with notice of enclosed instructions shown on exterior of crate, container, or packaging.
 - 3. Frequency of inspections and maintenance of stored items shall be in accordance with manufacturer’s written instructions.
 - 4. For mechanical equipment with bearings and shafts, manually rotate shaft during inspection and maintenance, as recommended by equipment manufacturer.
 - 5. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is connected to permanent electrical power supply.
 - 6. Other requirements for maintenance during storage of electrical equipment, instrumentation and controls, items with computer chips, solid-state devices and other electronics are in this Section’s provision on general protection during storage.

- C. Affidavits:
 - 1. Submit to Engineer affidavit for each time maintenance and inspection was performed on materials and equipment in long-term storage. Affidavit shall be signed by Contractor and entity performing the inspection and maintenance on the stored items.
 - 2. Indicate on affidavit:
 - a. Date of inspection.
 - b. Personnel involved and employer of each.
 - c. Condition of storage environment.
 - d. Specific stored items inspected, equipment condition, problems observed, problems corrected, maintenance tasks performed, and other relevant information.
 - e. Signature of Contractor’s person responsible for the inspection and maintenance.
 - f. Signed and notarized statement by items’ manufacturer indicating whether storage conditions and tasks performed are suitable for continued compliance with manufacturer’s warranties.
 - 3. Submit each affidavit, complete, not later than seven days after performing associated inspection and maintenance.

END OF SECTION

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SECTION 01 71 14
MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Construction mobilization and demobilization.
- B. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals to perform mobilization and demobilization for the Work.
 - 2. This Section is general and does not necessarily indicate all activities required for mobilization and demobilization, which may be indicated in other parts of the Contract Documents.,
- C. Related Requirements: Include, but are not necessarily limited to:
 - 1. Section 01 14 19 - Use of Site.
 - 2. Section 01 22 00 - Measurement and Payment.
 - 3. Section 01 29 73 - Schedule of Values.
 - 4. Section 01 74 00 - Cleaning.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and Payment:
 - 1. Where costs of mobilization and demobilization are to be included in a specific bid/pay item, such item is indicated in the Contract, including Section 01 22 00 - Measurement and Payment.
 - 2. Where the Contract does not expressly require costs for mobilization and demobilization are to be under specific bid/pay item(s), Contractor may allocate such costs among bid/pay items as Contractor deems appropriate.
 - 3. Where mobilization and demobilization is to be part of a larger lump sum bid/pay item, limitations on eligibility for payment of mobilization and demobilization costs are indicated in Section 01 29 73 - Schedule of Values.
- B. If costs for mobilization, demobilization, or both change as a result of Contract modifications, include the total cost of such changes to mobilization and demobilization in Change Proposal submitted for each associated change. Make no subsequent claim, whether via Change Proposal, Claim, or dispute, for additional compensation for mobilization, demobilization, or both.

1.03 MOBILIZATION AND DEMOBILIZATION - GENERAL

- A. Do not commence mobilization at the Site or other areas until:
 - 1. The Contract is signed by both parties and is effective.
 - 2. Required insurance documentation, performance bond, and payment bond have been submitted by Contractor and accepted by Owner, and builder's risk insurance complying with the Contract Documents is furnished and in place, and documentation thereof accepted by the parties.
 - 3. Conditions, if any, of Owner-issued Notice to Proceed, if any, have been complied with by the applicable party.
 - 4. Preconstruction conference(s), including items on agenda for site mobilization matters, is completed.
 - 5. Preconstruction photographic documentation is obtained and submitted in accordance with the Contract Documents.
- B. Mobilization Work includes, but is not limited to:
 - 1. Establishing vehicular access and parking in accordance with Section 01 14 19 - Use of Site.

2. Establishing Contractor's staging and laydown areas, in accordance with Section 01 14 19 - Use of Site.
 3. Establishing temporary utilities and temporary facilities in accordance with Section 01 51 05 - Temporary Utilities.
 4. Establishing required and necessary temporary project signage.
 5. Other mobilization Work required by the Contract Documents, including Section 01 22 00 - Measurement and Payment, and Section 01 29 73 - Schedule of Values.
- C. Demobilization Work includes, but is not limited to:
1. Removing from the Site and other areas Contractor's temporary utilities, temporary facilities, temporary signage, temporary security measures; construction equipment, machinery, and tools; unused items of materials and equipment; and other items.
 2. Final cleaning in accordance with Section 01 74 00 - Cleaning.
 3. Other demobilization Work required by the Contract Documents, including Section 01 22 00 - Measurement and Payment, and Section 01 29 73 - Schedule of Values.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION - (NOT USED)

SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Methods of installing and sealing openings and penetrations in construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 05 50 00 - Miscellaneous Metals.
 - 2. Section 07 62 00 - Flashing and Sheet Metal.
 - 3. Section 07 84 00 - Firestopping.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
 - g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 501, Class 1 Locations.
 - b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
 - c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 DEFINITIONS

- A. Corrosive Areas: For the purpose of this specification section, the following areas are defined as corrosive:
 - 1. Aeration Basins.
- B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.
- C. Washdown Areas: Areas having floor drains or hose bibbs.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. For each structure provide dimensioned or scaled (minimum 1/8 inches = 1 foot) plan view drawings containing the following information:

- a. Vertical and horizontal location of all required openings and penetrations.
 - b. Size of all openings and penetrations.
 - c. Opening type.
 - d. Seal type.
2. Manufacturer's installation instructions for standard manufactured products.

1.5 SITE CONDITIONS

- A. For purposes of this Project, water table level is approximately at elevation 5,713 ft AMSL.
- 1. Refer to subsurface geotechnical report(s) identified in SC-5.03 of 00 73 01 - Supplementary Conditions (EJCDC 800-2018) for more detailed analysis of groundwater at the Site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe Sleeves:
- 1. Areas listed as Corrosive Areas in PART 1:
 - a. Stainless steel, Type 316L.
 - b. Penetrations 24 inches diameter or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
 - c. Penetrations larger than 24 inches diameter: Stainless steel, ASTM A666, Minimum 1/4 inches thickness.
 - 2. All other Areas:
 - a. Steel, Hot-dipped galvanized after fabrication.
 - b. Penetrations 24 inches diameter or less: ASTM A53, Schedule 40.
 - c. Penetrations larger than 24 inches diameter: ASTM A36, Minimum 1/4 inches thickness.
- B. Backing Rod and Sealant: See Specification Section 07 92 00.
- C. Modular Mechanical Seals:
- 1. Acceptable manufacturers:
 - a. Link-Seal.
 - 2. Stainless steel bolts, nuts and washers.
- D. Firestopping Material: See Specification Section 07 84 00.
- E. Sheet Metal Sleeves:
- 1. Areas listed as Corrosive Areas in PART 1: Stainless steel: ASTM A240, Type 316L.
 - 2. All other areas: Galvanized steel: ASTM A653, G90.
 - 3. Minimum 12 GA.
- F. Commercial Wall Castings:
- 1. Ductile iron, ASTM A536.
 - 2. For wet/corrosive areas either side of penetration: Stainless Steel, ASTM A352 or ASTM A995.
 - 3. Grade equal to connecting piping system.

PART 3 - EXECUTION

3.1 FABRICATION

- A. Fabricate pipe sleeves in accordance with Specification Section 05 50 00.
- B. Fabricate sheet metal sleeves in accordance with Specification Section 07 62 00.
- C. Provide waterstop 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 inches larger than outside diameter of sleeve, pipe or ductwork.
5. For commercial castings, waterstop/anchor size to be manufacturer standard.
6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.

D. Factory or shop-coat painted components in accordance with Specification Section 09 96 00.

3.2 INSTALLATION AND APPLICATION

- A. Firestopping materials used in fire-resistance rated construction shall be in full compliance with Specification Section 07 84 00.
- B. Seal openings and penetrations in non-fire-resistance-rated construction in accordance with Specification Section 07 92 00.
- C. Obtain prior approval from Engineer when any opening larger than 100 square inches must be made in existing or newly completed construction.
- D. Perform HVAC penetrations in accordance with NFPA 90A.
- E. Perform electrical penetrations in accordance with NFPA 70, Article 501.
- F. 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.
 1. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.
- G. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top 3 IN above finish floors.
 1. In non-washdown areas, install sleeves with ends flush with finished surfaces.
- H. 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.
- I. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.
- J. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.
 1. Metal grating: See Specification Section 05 50 00.
- K. Where pipes, conduits or ducts are removed where passing through grating:
 1. Metal grating:
 - a. Provide banding at perimeter and cover opening with 1/4 inches plate of the same material of the grating.
 - b. See Specification Section 05 50 00.
- L. Do not cut into or core drill any beams, joists, or columns.
- M. Do not install sleeves in beams, joists, or columns.
- N. Do not install recesses in beams, joists, columns, or slabs.
- O. Field Cutting and Coring:
 1. Saw or core drill with non-impact type equipment.
 2. Mark opening and drill small 3/4 inches or less holes through structure following opening outline.
 3. Sawcut opening outline on both surfaces.
 - a. Knock out within sawcuts using impact type equipment.

- b. Do not chip or spall face of surface to remain intact.
 - c. Do not allow any overcut with saw kerf.
- P. Precast-Prestressed Concrete Construction:
- 1. Do not cut openings or core drill vertically or horizontally through stems of members.
 - 2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
 - 3. Cast openings and sleeves into flanges of units.
 - 4. Cast openings larger than 6 inches in diameter or 6 inches maximum dimension in units at time of manufacture.
 - 5. Cast openings smaller than 6 inches in diameter or 6 inches maximum dimensions in flanges of units at time of manufacture or field cut.
- Q. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.
- R. 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 inches each side of sleeve for concrete encasement.
 - b. Provide #4 dowels at 12 inches 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 inches each side of sleeve for concrete encasement.
- S. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.
- T. Refer to Drawings for location of fire-rated walls, floors, and ceilings.
- 1. Utilize firestopping materials and procedures specified in Specification Section 07 84 00 inches conjunction with scheduled opening type to produce the required fire rating.
- U. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.
- V. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.
- W. Modular Mechanical Seals:
- 1. Utilize one seal for concrete thickness less than 8 inches and two seals for concrete, 8 inches thick or greater.
 - 2. Utilize two seals for piping 16 inches diameter and larger if concrete thickness permits.
 - 3. Install seals such that bolt heads are located on the most accessible side of the penetration.
- X. Backer Rod and Sealant:
- 1. Install in accordance with Specification Section 07 92 00.
 - 2. Provide backer rod and sealant for modular mechanical seal applications.
 - a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.

3.3 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 2 inches larger than outside dimensions of duct, pipe, or conduits.
 - b. Type B - Saw cut or line-drill 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. Provide pipe sleeve with water ring for wet and/or washdown areas.
 - d. Type D - Commercial type casting or fabrication.
 - e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct or conduit spools.
 - f. Type F - Integrally cast pipe, duct or conduit.
 - g. Type G - Saw cut or line-drill and remove area 1 inch 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.
 - j. Type J - Grating Banding for any field cut openings.
2. Provide seals of material and method described as follows.
 - a. Category 1 - Modular Mechanical Seal.
 - b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Specification Section 07 62 00 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 1/2 inches larger than opening.
 - g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
 - h. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.
 3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.
 4. Furnish openings and sealing materials through existing floors, grating, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

**SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE
FOR NEW CONSTRUCTION**

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	C F I	7 Not Req 7	D F I ⁽¹⁾	Not Req Not Req 7	C F	7 Not Req
Through floors on grade above water table	C F I	4 Not Req 4	C F I ⁽¹⁾	7 Not Req 7	C F I ⁽¹⁾	4 Not Req 7
Through floors in washdown areas	C I	4 4	C H ⁽²⁾ I ⁽¹⁾	4 3 4	F H ⁽²⁾ I ⁽¹⁾	Not Req 3 7
Through exterior wall above grade	A B C	6 6 6	A B D H ⁽²⁾	5 5 Not Req 5	C H ⁽²⁾	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Req
Grating openings and penetrations	J	8	J	8	J	8

**SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE
FOR EXISTING CONSTRUCTION**

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 E	7 Not Req	B ⁽¹⁾ E ⁽³⁾ H ⁽²⁾	7 Not Req 7	B ⁽¹⁾ E ⁽³⁾ H ⁽²⁾	7 Not Req 7
Through floors on grade above water table	B	7	B	7	B	7
Through floors in washdown areas	G	3	G H ⁽²⁾	3 3	G H ⁽²⁾	3 3
Through exterior wall above grade	G	6	G ^{(1) (3)} H ⁽²⁾	5 5	G ^{(1) (3)} H ⁽²⁾	5 7
Roof penetrations	G	2	G ^{(1) (3)} H ⁽²⁾	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	G ^{(1) (3)} H ⁽²⁾	4 4	G ^{(1) (3)} H ⁽²⁾	4 4
Grating openings and penetrations	J	8	J	8	J	8

- (1) Multiple piping 18 inches and smaller or multiple conduits.
(2) Single pipe 18 inches and smaller or single conduit.
(3) Single pipe or conduit larger than 18 inches.

END OF SECTION

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SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements for cutting and patching Work.
- B. Scope:
 - 1. Contractor shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
 - 2. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:
 - a. remove and replace defective Work;
 - b. remove samples of installed Work as specified or required for testing;
 - c. remove construction required to perform required alterations or additions to existing construction;
 - d. uncover the Work for Engineer's observation of covered Work, testing, or inspection by testing entities, or observation by authorities having jurisdiction;
 - e. connect to completed Work not performed in proper sequence;
 - f. remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
 - g. make connections or alterations to existing or new facilities.
- C. Related Requirements:
 - 1. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 2. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.
 - 4. Section 31 23 00 - Earthwork.
 - 5. Section 31 23 10 - Excavation and Backfill.
 - 6. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Cutting and Patching Request:
 - a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:
 - 1) Design function or intent of Project.
 - 2) Work of Owner or other contractors retained by Owner.
 - 3) Structural capacity or integrity of an element of the Project, building, or structure.
 - 4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 5) Efficiency, operational life, maintenance, or safety of operational elements.
 - 6) Visual qualities of elements that will be exposed to view after completion of the Work.
 - b. Request shall include:
 - 1) Identification of Project and Contract designation.
 - 2) Description of affected Work of Contractor and work of others (if any) retained by Owner.
 - 3) Necessity for cutting.

- 4) Effect on work or operations of Owner and other contractors (if any) retained by Owner, and on structural and weatherproof integrity of Project, building, or structure.
 - 5) Description of proposed Work, indicating: scope of cutting and patching; trades that will execute the cutting and patching Work; materials and equipment to be used; extent of refinishing; schedule of operations; alternatives (if any) to cutting and patching, and net effect on aesthetics following completion of finishing Work.
 - 6) Indication of entity responsible for cost of cutting and patching, when applicable.
 - 7) Written permission of other prime contractors (if any) whose work will or may be affected.
2. Recommendation Regarding Cutting and Patching:
 - a. Should conditions of work or schedule indicate a change of materials or specified methods, furnish Submit written recommendation to Engineer including:
 - 1) Conditions indicating change.
 - 2) Recommendations for alternative materials or alternatives to specified methods.
 - 3) Material manufacturer's printed recommendations for the proposed product and recommendations of manufacturer's technical representative for the specific application(s). The latter shall be on technical representative's letterhead and shall explicitly indicate the Project and specific cutting and patching application(s) to which the recommendation(s) apply.
 - 4) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
 3. Product Data:
 - a. Submit manufacturer's published data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
 - b. When not required under other Specifications sections, submit manufacturer's published data on materials to be used for finishing around the cut or patched area(s), together with indication of the location(s) where each is proposed for use.
 - c. Furnish Submittals for patching materials under the associated Specifications section. Submittal to include letter of recommendation from product manufacturer's technical representative indicating on technical representative's letterhead, explicitly indicating:
 - 1) Project name and facility name;
 - 2) specific cutting and patching application(s) to which the recommendations apply;
 - 3) that product manufacturer's technical representative has personally observed and is familiar with conditions in the work area(s) of the subject cutting and patching;
 - 4) materials that are the subject of the Submittal are appropriate for the condition(s) of the proposed patch and will remain durable in the patch's final exposure upon Substantial Completion; and.
 - 5) patching material manufacturer's technical representative's recommendations for surface preparation, installation of patching material(s), and curing.
- B. Informational Submittals: Submit the following:
1. Written Notification of Cutting and Patching:
 - a. Furnish as a Submittal written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by Engineer.
 2. X-ray Investigations:
 - a. Proposed method of investigation. Submit and obtain Engineer's acceptance prior to performing x-ray inspections.
 - b. Report of x-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials – General:
 - 1. Provide materials that comply with the Contract Documents.
 - 2. If not shown or indicated in the Contract Documents, use materials identical to existing materials affected by cutting and patching Work.
 - 3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, provide materials whose installed performance will equal or surpass that of existing materials.
 - 4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.
- B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
 - 1. After core-drilling or sawcutting (as applicable) and before installing the utility or equipment through the penetration, coat exposed concrete and exposed steel with solvent-free, two-component, protective, epoxy resin coating.
 - 2. Color shall approximate the finish color of the existing surface to be coated.
 - 3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
 - a. Sikagard 62, by Sika Corporation.
 - b. Or equal.
- C. Grout Materials:
 - 1. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.
- D. Epoxy Bonding Adhesive:
 - 1. Provide two-component, moisture-insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.
 - 2. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.
 - 3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
 - a. Euco No.452 MV by Euclid Chemical Co.
 - b. Sikadur 32, Hi-Mod by Sika Corporation.
 - c. Or equal.
- E. Epoxy Patch Material:
 - 1. Engage the manufacturer's representative to observe and recommend a suitable patching material of the actual construction conditions.
 - 2. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
 - a. Depth of patch greater than 3/4 inches:
 - 1) Five Star MP Epoxy Patch.
 - 2) Or equal.
 - b. Depth of patch between 1/8 inches and 3/4 inches:
 - 1) Five Star Fluid Epoxy.
 - 2) Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Assessment – General:
 - 1. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
 - 2. Report unsatisfactory or questionable conditions to Engineer in writing.
 - 3. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

- B. Non-Destructive Investigation:
 - 1. In advance of cutting or coring through existing slabs or walls, use x-ray or other non-destructive methods accepted by Engineer to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs and walls.
 - 2. Submit to Engineer written report of findings of evaluation.
 - 3. Perform x-ray investigation and submit results to Engineer sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.2 PREPARATION

- A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.
- B. Protection of Existing Construction during Cutting and Patching:
 - 1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
 - 2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING AND PATCHING – GENERAL

- A. Perform cutting and coring in such manner that limits extent of patching required.
- B. Structural Elements:
 - 1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.
- C. Operating Elements:
 - 1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
 - 2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
- D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.
- E. Provide adequate temporary covering over openings (whether cut or core-drilled) where not in use. Avoid creating tripping hazards for openings provided in floors and slabs.

3.4 CORING

- A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by Engineer in writing.
- B. Coring:
 - 1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
 - 2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of Engineer. To extent possible, avoid cutting reinforcing steel in slabs and walls.
- C. Protection:
 - 1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
 - 2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph

2.1.B of this Specification Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:

1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. Cutting – General:

1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping. Carefully chip out concrete where necessary and as indicated in the Contract Documents.
3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
4. Prior to starting cutting, provide adequate bracing of area to be cut.
5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
6. Use equipment of adequate size to remove the cut panel or “coupon”.

B. Cutting – Concrete and Masonry:

1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
2. On both sides of the element being cut, provide for control of slurry generated during sawing.
3. Concrete Cutting:
 - a. Make openings by sawing through existing concrete. Core drill with 6 inches diameter core at the corners of openings to avoid overcutting at corners.
 - b. When the cut-out concrete or “coupon” cannot be removed in one piece, or where concrete is too thick for saw to penetrate fully, break out concrete after initial saw cuts.
 - c. Where saw cutting is not possible:
 - 1) Make openings by drilling holes around perimeter of required opening and subsequently carefully chip out concrete.
 - 2) Holes shall be sufficient in quantity to prevent damage to remaining concrete.
4. Sizing and Repair of Cut Concrete Surfaces:
 - a. Where reinforcing steel is cut, for openings indicated on the Drawings, remove existing reinforcing steel back to 1.5 inches below concrete surface. When using heat or torching to remove ends of reinforcing steel, remove adjacent, heat-damaged concrete prior to patching. Sides of resulting hole to be patched shall be approximately perpendicular to finished concrete surface. Provide bonding adhesive on surfaces of resulting holes and fill resulting holes with non-shrink grout in accordance with the Contract Documents.
 - b. Oversize required openings in existing concrete by one inch on all sides and build back to required opening size by providing epoxy grout bonded to existing concrete.
 - c. Where oversizing the cut opening by one inch is not possible, cut the opening to the required dimensions. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specifications Section. Apply protective coating in accordance with manufacturer's instructions.
 - d. Where indicated, finish remaining surfaces as indicated in Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

3.6 PATCHING

A. Patching – General:

1. Patch large openings to be filled with concrete in accordance with the Contract Documents. Before installing new concrete, apply bonding adhesive indicated in Paragraph 2.1.C of this Specifications section in accordance with manufacture's recommendations.
2. Where large openings to be filled with concrete are indicated on the Drawings as requiring reinforcing steel, provide reinforcing steel as shown and indicated in the Contract Documents. Where openings in existing reinforced concrete are larger than 2 feet in diameter or 2 feet by 2 feet and the Drawings or elsewhere in the Contract Documents do not expressly require reinforcing steel for the opening, submit a request for interpretation to Engineer and obtain Engineer's response before proceeding.
3. Where concrete infill or grout repair materials are not used, patch using epoxy patch material indicated in Paragraph 2.1.D of this section unless otherwise indicated on Drawings.
4. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
5. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents and the published installation instructions of the material's manufacturer.
6. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
7. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
2. For continuous surfaces, refinish to nearest intersection.
3. For an assembly, refinish the entire unit that was patched.
4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Cleaning and Restoration:

1. Perform cleaning promptly after associated cutting, coring, and patching.
2. Clean areas and spaces where cutting, coring, or patching were performed.
3. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
4. Restore damaged coverings of pipe and other utilities to original condition.

END OF SECTION

SECTION 01 74 00 CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for keeping the Site free of accumulations of waste materials during construction (“progress cleaning”).
 2. Cleaning for Substantial Completion and prior to final inspection (collectively, “closeout cleaning”).
 3. Removal of grit from Aeration Basin 04 (AB 04).
- B. Scope:
1. Contractor shall perform cleaning during the Project, including progress cleaning, as condition precedent to Substantial Completion, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, this Specifications section, and elsewhere in the Contract Documents.
 2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.
 3. Grit removed from AB 04 shall be disposed of in a landfill by the Contractor. Grit and other solids removed from AB 04 shall pass the Paint Filter Liquids Test (Test Method 9095B) to ensure no free liquid remains in the solids. The grit and other solids shall pass the Paint Filter Liquids Test prior to trucking and disposal. Refer to Specification 02 41 00 – Demolition for other requirements associated with transportation and disposal of non-hazardous materials.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. National Fire Protection Association (NFPA):
 - a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

- A. Progress Cleaning – General:
1. Clean the Site, work areas, and other areas occupied by Contractor not less than weekly. Dispose of waste materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
 - a. Comply with NFPA 241 for removing combustible waste materials and debris.
 - b. Do not hold non-combustible materials at the Site more than three days if the ambient air temperature is expected to rise above 80 degrees F. When ambient air temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.
 - c. Provide suitable containers for storage of waste materials and debris. Avoid generation of odors and creation of nuisances.
 - d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.
- B. Progress Cleaning – Site:

1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
 2. Not less than weekly, brush-sweep roadways and paved areas at the Site and adjacent areas used by construction vehicles or otherwise affected by construction activities.
- C. Progress Cleaning – Work Areas:
1. Clean areas where the Work is in progress to maintain an extent of cleanliness necessary for proper execution of the Work and safety of personnel.
 2. Remove liquid spills promptly. Where spills may have harmful effects on health, safety, protection of facilities, or the environment, immediately report spills to Owner, Engineer, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
 3. Where dust would impair proper execution of or quality of the Work, broom-clean or vacuum entire work area, as necessary.
 4. Concealed Spaces: Remove waste material and debris from concealed spaces before enclosing the space.
- D. Progress Cleaning – Installed Work:
1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of installed materials and equipment, using only cleaning agents and methods specifically recommended by material or equipment Supplier.
 2. If Supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage or mar exposed surfaces.
- E. Progress Cleaning – Exposed Surfaces:
1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.
- F. Progress Cleaning – Cutting and Patching:
1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
 2. Comply with Section 01 73 29 - Cutting and Patching, regarding cleaning during and after cutting and patching Work.
 3. Thoroughly clean piping, ductwork, conduits, and similar features before applying patching material, paint, or other finishing materials.
 4. Restore damaged insulation and coverings on piping, cutwork, and similar items to its pre-construction condition.
- G. Cleaning of Hydraulic Structures:
1. Do not perform field quality control activities such as testing tanks, channels, and other hydraulic structures for leakage or disinfecting (where applicable), and do not apply for inspection for Substantial Completion for hydraulic structures, until the associated hydraulic structures are clean and free of all waste materials, and ready for intended use.
- H. Waste Disposal:
1. Properly dispose of waste materials (including surplus materials, debris, rubbish, and other waste) off the Site.
 2. Do not burn or bury waste materials at the Site.
 3. Remove waste material and rubbish from excavations before backfilling.
 4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers, gutters, sanitary sewers, or other location in the environment. Dispose of such materials in accordance with Laws and Regulations.
 5. Do not discharge wastes to surface waters, drainage routes, or groundwater.
 6. Contractor is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by Contractor's operations or brought to the Site by Contractor.

- I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where necessary or required for protection from damage or deterioration, until Substantial Completion.
- J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

- A. Complete the following prior to requesting inspection for Substantial Completion:
 - 1. Clean and remove from the Site waste material (including rubbish and debris) and other foreign and undesirable items and substances.
 - 2. Sweep broom-clean paved areas suitable for access by vehicles.
 - 3. Remove spills and stains or petroleum, oils, solvents, other chemicals, and other foreign and undesirable deposits.
 - 4. Hose-clean sidewalks and loading areas.
 - 5. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 6. Surface waterways and drainage routes (including storm sewers, gutters, and ditches) shall be open and clean.
 - 7. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to preconstruction condition.
 - 8. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign and undesirable substances.
 - 9. Clean, wax, and polish wood, vinyl, and painted floors.
 - 10. Remove waste material and surface dust from limited-access spaces, including roofs, plenums, shafts, trenchway, equipment vaults, manholes, and similar spaces.
 - 11. In unoccupied spaces, sweep concrete floors broom-clean.
 - 12. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - 13. Remove non-permanent tags and labels.
 - 14. Surface Finishes:
 - a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
 - b. Do not paint over “UL” or similar labels, including mechanical and electrical nameplates.
 - 15. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign or undesirable substances.
 - 16. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
 - 17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - 18. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - 19. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.
- B. Complete the following prior to requesting final inspection:
 - 1. After Substantial Completion of all the Work, following completion of items of incomplete or damaged Work (“punch list Work”), clean “punch list Work areas in accordance with Paragraph 3.2.A of this Specifications Section.
 - 2. Remove field offices, Contractor’s storage sheds, and remaining stockpiles and clean all such areas in accordance with Paragraph 3.2.B of this Specifications Section, and in accordance with Contract Documents for landscaping and restoration.

END OF SECTION

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SECTION 01 75 00
CHECKOUT AND START-UP PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Administrative and procedural requirements for checkout and startup of equipment, systems, and facilities.
- B. Scope:
1. Contractor shall initially check out, start up, and place equipment and systems installed under the Contract into successful operation, in accordance with the material and equipment manufacturers' written instructions, Suppliers' recommendations at the Site, and the Contract Documents.
 2. Provide the following:
 - a. All labor, tools, materials, and equipment required to complete equipment and system checkout and startup.
 - b. Chemicals, lubricants, and other required operating fluids necessary for checkout, startup, and initial operation of the Work.
 - c. Filters and other temporary or consumable items necessary for checkout, startup, and initial operation of the Work.
 - d. Fuel, electricity, water, and other temporary utilities and temporary facilities necessary for checkout and startup of equipment and systems, unless otherwise specified.
 3. The General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19 - Closeout Requirements, address requirements for documenting Substantial Completion.
- C. Related Sections include but are not necessarily limited to:
1. Section 01 61 03 - Equipment - Basic Requirements.
 2. Section 01 77 19 - Closeout Requirements.
 3. Section 01 78 23 - Operation and Maintenance Data.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate checkout and startup with other contractors, as necessary.
 2. Do not start up equipment or system(s) for continuous operation until all components of that equipment item or system, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
 3. Subject to the constraints of this Specifications section, Owner will furnish sufficient personnel to assist Contractor in starting up equipment and system(s), but responsibility for proper operation of the Work is Contractor's.
 4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to Engineer or otherwise required by the Contract Documents.
 5. For startup of heating equipment, air conditioning equipment, and other equipment and systems that provide temperature control, that are dependent upon the time of year, return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate equipment and system(s).
 6. Do not start up equipment and system(s), without submitting acceptable preliminary operations and maintenance manuals by Contractor in accordance with the Contract Documents.
- B. Checkout and Startup Planning Meeting:

1. Contractor, with appropriate Subcontractors and Suppliers, shall attend and participate in a meeting with Owner, facility manager, and Engineer to discuss planning, scheduling, and coordination of checkout and startup activities.
 2. Upon mutual concurrence of Owner, Engineer, and Contractor, meeting may be concurrent with the training scheduling planning meeting.
 3. Meeting shall be held by the earlier of: (1) not less than 60 days prior to first scheduled training session for the equipment and system(s) to be checked out and started-up, and (2) not less than 60 days prior to the checkout and startup of the associated equipment and system(s).
 4. Attend meeting prepared to knowledgably and effectively discuss:
 - a. Status of the Work and schedule-to-complete for requirements prerequisite to checkout and startup.
 - b. Schedule for and status of training required for each equipment item and system.
 - c. Schedule for checkout, startup, and field quality control activities for the subject Work.
 - d. Status and quantities of required consumables, lubricants, and utility services necessary for checkout and startup.
 5. Meeting will be chaired by Engineer. Engineer will prepare and distribute a record of topics discussed and decisions made during the meeting. If meeting is concurrent with the training planning meeting, Contractor shall chair and prepare minutes of the training scheduling planning portion of the meeting and furnish its draft minutes to Engineer to incorporate into the overall minutes.
 6. Comply with decisions made at the meeting and the Contract Documents.
- C. Sequencing:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations, regarding staging (phasing) of the Work and allowable shutdowns.
- D. Scheduling:
1. Progress Schedule:
 - a. Clearly indicate in the Progress Schedule planned and actual dates for checkout, startup, and field quality control activities, including all demonstration testing activities addressed in this Specifications section and elsewhere in the Contract Documents. Separately indicate checkout, startup, and field quality control activities for each equipment item and system.
 - b. Perform startup and field quality control activities on the associated, scheduled dates, unless otherwise acceptable to Owner, facility manager, and Engineer.
 2. Restrictions for Scheduling:
 - a. Checkout of materials, equipment, and systems by Contractor that do not involve or require Owner's or facility manager's personnel may be performed at any time during normal working hours. Where required by the Contract Documents or requested by Engineer, perform checkout in the presence of Engineer or Resident Project Representative (RPR).
 - b. Startup, including initial operation of materials, equipment, and systems, shall not be initiated on: Monday, Friday, Saturday, Sunday, Owen's holidays, the day immediately prior to a holiday, or the day immediately following a holiday, unless otherwise acceptable to Owner, facility manager, and Engineer.
 - c. Unless otherwise indicated in the Contract Documents or acceptable to Owner, facility manager, and Engineer, perform all startup during normal working hours of the day shift.
 - d. To the extent practicable, where extended-duration startup or field quality control activities are required by the Contract, avoid having such activities extend into evening, night, weekend, or holiday hours.
 - e. Owner reserves the right to require a minimum seven days' notice of rescheduled startup when Contractor cannot perform the associated activities as scheduled.
 3. Operation and Maintenance Data:
 - a. Comply with Section 01 78 23 - Operation and Maintenance Data.

- b. A preliminary copy of all operation and maintenance manuals shall be received by Engineer prior to the start of the demonstration period.
- 4. Training:
 - a. Comply with training requirements indicated in each equipment section.
- 5. Spare Parts, Tools, and Extra Materials.
 - a. Furnish spare parts, tools, and extra materials to Owner as required for regular maintenance of Contractor-furnished equipment and for documenting Owner's receipt of such items.
 - b. Deliver to Owner all required spare parts, tools, and extra materials prior to commencing the demonstration period, unless earlier delivery is required elsewhere in the Contract Documents.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Do not start up equipment or systems or place into initial operation until required operating permits are obtained from authorities having jurisdiction.
 - 2. Where Owner (with or without assistance of Engineer) has applied for and obtained initial approvals or permits necessary for operation, Contractor shall furnish information and assistance to Owner or Engineer for Owner to secure final approvals from authorities having jurisdiction for required operating permits.

1.4 DEFINITIONS

- A. The following defined terms are used in this Specifications Section:
 - 1. Instrumentation Supplier: Entity retained by Contractor, Subcontractor, or Supplier to furnish instrumentation or controls that will be part of the completed Work, including manufacturers, manufacturer representatives, wholesalers, retailers, and others, including entities retained to perform systems integration Work.
 - 2. Project Classified System (PCS): An established, distinct part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, cabling, materials, and incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. PCSs may be specifically indicated in this Specifications section or elsewhere in the Contract Documents, such as Section 01 13 13 - Milestones, Section 01 14 16 - Coordination with Owner's Operations, and others.
 - 3. 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:
 - a. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
 - b. Equipment start-up.
 - c. Personnel training.
 - 4. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Data collection and reporting log for each required Demonstration Period.
- B. Informational Submittals: Submit the following:
 - 1. Progress Schedules indicating dates for checkout, startup, and field quality control activities.
 - 2. Completed checkout and startup log required in Paragraph 3.2.C of this Specifications section.

3. Manufacturer's installation check letters (also known as Manufacturer's Field Services Report) required in Paragraph 3.2.C of this Specifications section.
4. Instrumentation Supplier's Instrumentation Installation Certificate, required in Paragraph 3.2.C of this Specifications section.
5. Letter verifying completion of all pre-demonstration startup activities, required in Paragraph 3.2.C of this Specifications section.
6. Report of data collected during each required Demonstration Period.
7. Qualifications Statements:
 - a. Qualifications, including resume' and copy of license, of Contractor-retained licensed operator.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 CHECKOUT AND STARTUP – GENERAL

- A. Facility Startup Divided into Two Periods:
 1. Pre-Demonstration Period including:
 - a. Obtain Engineer's approval or acceptance (as applicable) of Submittals required prior to checkout and startup, including all Shop Drawings, Samples, source quality control (shop testing) Submittals, preliminary operation and maintenance manuals, and other Submittals required by the Contract Documents, other than Submittals that cannot be furnished until after startup.
 - b. Complete the Work to a point ready for checkout and startup, including operation available in all manual, automatic, and other modes.
 - c. Checkout and initial field quality control activities that can be performed prior to startup of the equipment or system.
 - d. Startup of the associated Work.
 - e. Field quality control activities for the subject Work as indicated elsewhere in the Specifications and other Contract Documents, other than this section.
 - f. Training of operations and maintenance personnel.
 2. Demonstration Period, including:
 - a. Demonstration of functional integrity of equipment, system, or PCS.

3.2 PRE-DEMONSTRATION PERIOD

- A. Prior to the Pre-Demonstration Period, complete the Work to the point where it is ready for checkout and startup.
- B. Checkout.
 1. Comply with Section 01 61 03 - Equipment - Basic Requirements, including provisions concerning installation checks.
- C. Startup:
 1. Comply with requirements for startup of materials, equipment, and systems indicated in the associated Specification sections and elsewhere in the Contract Documents.
 2. Prepare the Work so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
 3. Perform startup to extent possible without introducing process flow.
 4. Testing equipment requiring a fluid:
 - a. Blowers: using outside air via blower suction header.
 - b. MLR pumps: using mixed liquor (process flow). Coordinate basin mixed liquor filling with Owner's operations.
 - c. Anoxic mixers: using mixed liquor (process flow). Coordinate basin mixed liquor filling with Owner's operations.
 5. Procedures include but are not necessarily 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 of all closed systems.
 - 7) Lubrication.
 - 8) Valve orientation and position status for manual operating mode.
 - 9) Pumping equipment using process flow.
 - 10) Instrumentation and control signal generation, transmission, reception, and response.
 - a) Comply with Section 40 90 00 - Instrumentation for Process Control - Basic Requirements.
 - 11) Tagging and identification systems.
 - 12) Proper connections, alignment, calibration and adjustment.
- b. Calibrate 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 Work ready for Demonstration Period.
- f. Checkout and Startup Log:
 - 1) Prepare a log showing each equipment item and system requiring checkout and startup. Indicate in the log activities to be accomplished during checkout and startup.
 - 2) Provide a place for Contractor to record date and person performing required checkout and startup. Indicate associated date(s), personnel, and employer of each.
 - 3) Submit completed checkout and startup log to Engineer and obtain Engineer's acceptance.
6. Obtain Suppliers' certifications of the installed and operational Work, without restrictions, and submit to Engineer:
 - a. Manufacturer's installation check letters (sometimes referred to as Manufacturer's Field Services Report).
 - b. Instrumentation Supplier's Instrumentation Installation Certificate.
7. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from Suppliers as final item prior to initiation of Demonstration Period.
8. Personnel Training:

3.3 DEMONSTRATION PERIOD

- A. Demonstration Period – General:
 1. Demonstrate the operation and performance of mechanical, electrical, instrumentation, and control interfaces of the Work undergoing the Demonstration Period, in accordance with the Contract Documents.
 2. Duration of Demonstration Period: 168 consecutive hours.
 3. If, during the Demonstration Period, the aggregate time used for repair, alteration, or unscheduled adjustments to any part of the Work that renders the affected Work inoperative or operation outside of recommended ranges exceeds 10% of the Demonstration Period, the demonstration of operation and performance will be deemed unacceptable and Contractor shall provide appropriate adjustments and remedies and re-perform the Demonstration Test, at no additional cost to Owner or facility manager, until acceptable results are obtained. Re-performance of the Demonstration Period shall comply with the same requirements as the original Demonstration Period.
 4. Perform the demonstration of operation and performance of the Work under full operational conditions.

5. Owner's or Facility Manager's Personnel:
 - a. Owner or facility manager (as applicable) will make available operations personnel to make process decisions affecting facility performance and compliance with applicable operating permits.
 - b. Owner's or facility manager's assistance will be available only for process decisions.
 - c. Contractor will perform all other functions associated with the Demonstration Period including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period in accordance with the Contract Documents.
 6. Owner or facility manager reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, and similar actions and events during the Demonstration Period to verify the operation and performance of the Work in automatic, manual, and other types of operating modes, backup systems, and alternate operating modes.
 7. Prior to Starting Demonstration Period:
 - a. Prepare data collection and reporting log for sampling, analytical data, and data to be obtained by manually recording data from field or panel indicators. Not less than 30 days prior to the start of the Demonstration Period, submit the data collection and reporting log to Engineer for acceptance.
 8. Timing of Start and End of Demonstration Period:
 - a. Schedule the end of the Demonstration Period at a convenient time such as midnight, so the Owner or facility manager can assume operational responsibility on a new day beginning immediately after completion of the Demonstration Period.
 - b. Time of beginning and ending Demonstration Period shall be agreed upon by Contractor, Owner (and facility manager, if other than Owner), and Engineer in advance of initiating Demonstration Period.
- B. Demonstration Period, Evaluation, and Acceptance:
1. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's or facility manager's questions, provide final field instruction on select systems (where appropriate) and to respond to problems or failures of the Work.
 2. Responsibilities for Sampling and Data Collection:
 - a. Use the data collection and reporting log format accepted by Engineer. Indicate data clearly and legibly.
 3. Responsibilities for Data Reporting:
 - a. Submit data collected to Engineer for evaluation of acceptability of results.
 4. Data Evaluation:
 - a. Engineer, in consultation with Owner and facility manager (as applicable) as necessary, will evaluate the data collected during the Demonstration Period and other information obtained during the Demonstration Period for compliance with the Contract Documents.
 - b. Engineer will advise Contractor in writing of whether the data and information obtained indicate that the Demonstration Period was successfully completed.
 5. Criteria for Acceptance:
 - a. Tolerance for Acceptance as indicated in section for each equipment.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for:
1. Substantial Completion.
 2. Final inspection.
 3. Request for final payment and acceptance of the Work.

1.2 SUBSTANTIAL COMPLETION

- A. Substantial Completion – General:
1. Prior to requesting inspect no for Substantial Completion, perform the following for the substantially completed Work:
 - a. Materials and equipment for which Substantial Completion is requested shall be fully ready for their intended use, including full operating and monitoring capability in automatic, manual, and other operating modes set forth in the Contract Documents.
 - b. Permanent provisions for safety and protection, shown and indicated in the Contract Documents and associated with the substantially completed Work or for personnel accessing and using the substantially completed Work, shall be in place and ready for their intended use.
 - c. Complete field quality control Work, including inspections and testing at the Site, indicated in Specifications sections for individual materials and equipment items and related Contract Documents. Submit results of, and obtain Engineer’s acceptance of, field quality control tests and inspections required by the Contract Documents.
 - d. Complete checkout and startup in accordance with Section 01 75 00 - Checkout and Startup Procedures, requirements of the Specifications for the various materials and equipment in the substantially completed Work, and related Contract Documents.
 - e. Cleaning for Substantial Completion shall be completed in accordance with Section 01 74 00 - Cleaning.
 - f. Spare parts, tools, and extra materials shall be delivered and accepted in accordance with the Contract Documents and documentation of Owner’s acceptance thereof has been submitted to Engineer in acceptable form.
 - g. Training of the facility’s operations and maintenance personnel shall be completed in accordance with the Contract Documents.
 - h. Submit and obtain Engineer’s acceptance of final operations and maintenance manuals in accordance with Section 01 78 23 - Operation and Maintenance Data.
 - i. Obtain and submit to Engineer all required permits, inspections, and approvals of authorities having jurisdiction for the substantially completed Work to be occupied and used by Owner.
 - j. Complete other tasks that the Contract requires be completed prior to Substantial Completion.
 2. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.
 3. Sample letter for Contractor’s request for inspection for Substantial Completion is attached to this Specifications section. Use the model language of the sample letter, modified to suit the Project and the needs of Contractor’s request.
 4. Unless decided otherwise by Owner and Engineer, form of certificate of Substantial Completion will be EJCDC C-625, “Certificate of Substantial Completion” (2018 edition or later), prepared by Engineer.
 5. Refer to the Agreement and Section 01 29 76 - Progress Payment Procedures, for requirements regarding consent of surety to partial release of or reduction in retainage.

1.3 FINAL INSPECTION

- A. Final Inspection – General:
1. Prior to requesting final inspection, verify that all the Work is fully complete and ready for final payment. Partial checklist for this purpose is attached to this Specifications section.
 2. Sample letter for Contractor to request final inspection is attached to this Specifications section. Use the model language of the sample letter, modified to suit the Project.
 3. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions, and as augmented in this Specifications section.

1.4 REQUEST FOR FINAL PAYMENT AND ACCEPTANCE OF THE WORK

- A. Procedure:
1. After successful completion of the final inspection, submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions, and using procedure specified in Section 01 29 76 - Progress Payment Procedures, and this Specifications section.
 2. Acceptance of the Work:
 - a. Upon Engineer’s concurrence that the Work is complete and ready for final payment (as a result of the final inspection and other communications between the parties and Engineer) and receipt of the final Application for Payment, accompanied by other required Contract closeout documentation, all in accordance with the Contract Documents, Engineer will issue to Owner and Contractor a notice of acceptability of the Work, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
 - b. Unless decided otherwise by Owner and Engineer, form of acceptance will be EJCDC C-626, “Notice of Acceptability of Work”, (2018 edition or later).
 - c. Nothing other than receipt of such notice of acceptability from Engineer constitutes acceptance of the Work.
 - d. Receipt of Engineer’s notice of acceptability of the Work does not relieve Contractor of Contractor’s continuing obligations under the Contract, including correction period obligations, warranty obligations, indemnification obligations, insurance requirements, and Contractor’s other obligations following acceptance of the Work by Engineer and final payment. Such obligations shall commence and remain in effect as indicated elsewhere in the Contract Documents.
- B. Request for final payment shall include:
1. Documents required for progress payments in Section 01 29 76 - Progress Payment Procedures.
 2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
 3. List, on Contractor’s letterhead, of all Change Proposals, Claims, and disputes that Contractor believes are unsettled. If there are no such Change Proposals, Claims, or disputes, so indicate in writing.
 4. Consent of Surety to Final Payment:
 - a. Acceptable form includes AIA G707, “Consent of Surety to Final Payment” (1994 or later edition), or other form acceptable to Owner.
 5. Releases of Liens:
 - a. Submit complete and legally effective releases (satisfactory to Owner) of all Liens filed in connection with the Work, regardless of whether such Lien was filed by Contractor, Subcontractor, or Supplier.
 - b. Each release of Lien shall be signed by an authorized representative of the entity submitting the release of Lien, and shall include Contractor’s, Subcontractor’s, or Supplier’s (as applicable) corporate seal, when applicable.
 6. Waivers of Lien Rights:

- a. Submit legally-binding waivers of rights to file Liens, acceptable to Owner, as required in the General Conditions (as may be modified by the Supplementary Conditions) from Contractor and each Subcontractor and Supplier that furnished or provided labor, material, or equipment totaling \$1,000 or more for the Work.
- b. Furnish final list of Subcontractors and Suppliers indicating final amount of the associated subcontract or purchase order for each. Include on the list all lower-tier Subcontractors and Suppliers retained by higher-tier Subcontractors and Suppliers. Prepare the list using the form included in Section 01 29 76 - Progress Payment Procedures.
- c. Each waiver of Lien rights shall be signed by an authorized representative of the entity submitting waiver of Lien rights, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
- d. Waiver of Lien rights may be conditional upon receipt of final payment.
- e. Required Affidavits: Submit the following:
 - 1) Affidavit of payment of debts and claims, submitted by Contractor. Acceptable form includes AIA G706, "Contractor's Affidavit of Payment of Debts and Claims" (1994 or later edition), or other form acceptable to Owner, and;
 - 2) Affidavit of release of Liens, submitted by Contractor. Acceptable form includes AIA G706A, "Affidavit of Release of Liens" (1994 or later edition).
 - 3) Each affidavit shall be signed by an authorized representative of Contractor and shall bear Contractor's corporate seal, as applicable.
- f. In the event Contractor is unable to obtain one or more required waivers of Lien rights, recourse is set forth in the General Conditions, as may be modified by the Supplementary Conditions.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The documents listed below, following this Specification section's "End of Section" designation, are part of this Specifications section:
 1. Sample letter for Contractor's use in requesting inspection for Substantial Completion (two pages).
 2. Sample partial checklist to identify readiness for final inspection (four pages).
 3. Sample letter for Contractor's use in requesting final inspection (one page).
 4. Waiver of Lien Rights (one page).
- B. In the model language of the attached sample letters for Contractor to request inspection for Substantial Completion and the final inspection, language in brackets, e.g., "[insert date]" or "[____]", indicates instructions to the drafter of the letter and often indicates specific information to be inserted by Contractor; do not include bracketed, italicized text in the final version of the letter(s) prepared for the Project. Non-italicized language in brackets is optional language; use the appropriate language to complete the actual letter for the Project and edit where required to suit the specific circumstances.

END OF SECTION

**SAMPLE LETTER FOR CONTRACTOR'S USE IN
REQUESTING INSPECTION FOR SUBSTANTIAL COMPLETION**

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[Date]

Brad Bjerke
HDR
412 E. Parkcenter Blvd., Suite 100
Boise, ID 83706

Subject:
Ketchum / SVWSD WRF Aeration Upgrades, HDR Project No. 10360008
Request for Inspection for Substantial Completion

Dear Brad:

In our opinion, [all of] [or] [a portion of] the Work under the above-referenced Contract is substantially complete as of [insert month, day, year on which Substantial Completion was achieved]. [The specific portion of the Work that we believe is substantially complete is [insert identification of that portion of the Work that is substantially complete].]

Enclosed is our listing of uncompleted Work items (“punch list”). In accordance with Paragraph 15.03.A of the General Conditions, we hereby request: (1) That the Engineer schedule and perform the inspection for Substantial Completion as soon as possible, and (2) Issuance of the certificate of Substantial Completion.

In accordance with Paragraph 15.03.D of the General Conditions, upon Substantial Completion, we propose the following relative to apportionment of responsibilities between the Owner and the Contractor:

1. Security, Protection, Insurance:
 - a. Site Security: [insert proposal; address whether Owner or Contractor will be responsible for security of the Site].
 - b. Protection of the Substantially Completed Work: [insert proposal; address whether Owner or Contractor will be responsible for protection].
 - c. Property Insurance: [insert proposal; typically Owner assumes responsibility for property insurance upon Substantial Completion]
2. Operation and Maintenance:
 - a. Operation: [insert proposal; address whether Owner or Contractor will be responsible for operating the substantially completed Work].
 - b. Maintenance: [insert proposal; address whether Owner or Contractor will be responsible for maintaining the substantially completed Work].
3. Utilities: [for each of the following, indicate whether Owner or Contractor will be responsible for utilities and services, or whether responsibility will be shared; if shared, indicate proposed cost-sharing]
 - a. Electricity: [insert proposal].
 - b. Natural Gas/Fuel/Heating: [insert proposal].
 - c. Water Supply: [insert proposal].

- d. Wastewater: [insert proposal].
- e. Communications (Telephone, Internet, Video): [insert proposal].

In accordance with Paragraph 15.08.A of the General Conditions, we understand that the Contract's correction period for the Work covered by the certificate of Substantial Completion commences on the Substantial Completion date documented in said certificate. [Drafter: Also see Paragraph 15.04 ("Partial Utilization") of the General Conditions and, where necessary, edit this paragraph of the letter accordingly.]

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]
[Signatory's title]

Attachments:

Preliminary list of uncompleted Work items ("punch list"; [##] pages)

Copies:

[Owner's project manager]

SAMPLE PARTIAL CHECKLIST TO IDENTIFY READINESS FOR FINAL INSPECTION

Project: Ketchum / SVWSD WRF Aeration Upgrades

Contract: HDR Project No. 10360008

Contractor: [_____]

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
1. All Submittals, including all Shop Drawings and Samples, approved or accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
1. Final services completed by Suppliers, including submittal of "Manufacturer Field Service Report" in Section 01 61 03 Equipment - Basic Requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
2. Final Work completed by Subcontractors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
3. Permits closed out and regulatory compliance transitioned from construction to operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
4. All outstanding change issues are addressed and all Change Proposals submitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
5. All Change Proposals and Claims are resolved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
<i>Remarks:</i>						
6. All defective Work of which Contractor is aware has been corrected in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
7. Issues related to Constituents of Concern and potential Hazardous Environmental Condition have been fully addressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
8. All spare parts, tools, and extra materials have been furnished in accordance with the Contract Documents, and documentation thereof submitted to Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
9. All final operations & maintenance manuals have been submitted and accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
10. Manufacturer warranties and software license(s) furnished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
11. Instruction and training of operations and maintenance personnel is complete and records of training submitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
<i>Remarks:</i>						
12. MBE/WBE/DBE/VBE compliance report(s) submitted (when applicable)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
13. All field engineering Submittals, including survey data, furnished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
14. All Work on "punch list" is complete in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
15. All record documents submitted to and accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
16. Contractor is fully demobilized from the Site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
17. All Site restoration is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
18. Final cleaning of all work areas is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
19. Releases of Liens and waivers of Lien rights (or acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
alternative) obtained from Subcontractors and Suppliers						
<i>Remarks:</i>						
20. Evidence of Contractor liability insurance furnished for correction period	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
21. All other required Contract closeout documents obtained	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
<i>Remarks:</i>						
22. All other Work and documentation required prior to final payment is complete and provided in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						

**SAMPLE LETTER FOR CONTRACTOR'S USE IN
REQUESTING FINAL INSPECTION**

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[Date]

Brad Bjerke
HDR
412 E. Parkcenter Blvd., Suite 100
Boise, ID 83706

Subject:
Ketchum / SVWSD WRF Aeration Upgrades, HDR Project No. 10360008
Request for Final Inspection

Dear Brad:

The Work under the above-referenced Contract is complete and ready for final payment as of [insert month, day, year on which final completion was achieved]. In accordance with Paragraph 15.05 of the General Conditions, we hereby request that the Engineer schedule and perform the final inspection as soon as possible. Upon successful completion of the final inspection, we will submit our final Application for Payment accompanied by the required Contract closeout documentation in accordance with the Contract Documents.

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]
[Signatory's title]

Attachments:
None

Copies:
[Owner's project manager]

SECTION 01 78 23
OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for Contractor-furnished, manufacturers' operation and maintenance (O&M) data, including:
 - a. Required operation and maintenance data groupings into operation and data manuals and timing of such Submittals.
 - b. Requirements for paper copies of operation and maintenance data and related Electronic Documents.
 - c. Content of operation and maintenance data Submittals.
- B. Scope:
1. Contractor shall submit operation and maintenance data, and related information, in accordance with this Section and requirements elsewhere in the Contract Documents, as instructional and reference information for use by: (a) Owner's operation and maintenance personnel, and (b) others retained by or working for Owner.
 2. In addition to operation and maintenance data expressly required elsewhere in the Contract Documents, also submit operation and maintenance data for:
 - a. All equipment and systems, including facility equipment, conveying equipment, fire suppression systems, plumbing equipment, HVAC equipment, electrical equipment, communications equipment, electronic safety and security systems, utility equipment, transportation equipment, waterway and marine equipment, and process equipment, and other equipment.
 - b. Valves, gates, actuators, and related accessories.
 - c. Instrumentation and control devices and systems.
 - d. Building materials, systems, and finishes that need post-construction troubleshooting, cleaning, or maintenance, such as roofing, doors, windows, louvers, flooring, paint and coatings, other finishes, and other items.
- C. Related Requirements:
1. Section 01 33 00 - Submittal Procedures.
 2. Section 01 75 00 - Checkout and Startup Procedures.
 3. Section 01 78 36 - Warranties.

1.2 SUBMITTALS

- A. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
 - a. Submit operation and maintenance data, required by the Contract Documents, grouped into operation and maintenance manual Submittals indicated in Table 01 78 23-A.
 - b. Where operation and maintenance data required by the Contract Documents, is not expressly indicated in table 01 78 23-A, obtain written clarification or interpretation from Engineer prior to preparing and transmitting such Submittal.
 - c. For each required operation and maintenance manual Submittal, furnish preliminary Submittal and final Submittal. Timing of preliminary and final operation and maintenance manual Submittals, and differences between preliminary and final Submittals, are indicated in this Section.

**Table 01 78 23-A
Required Groupings of Operation and Maintenance Data Submittals**

Name of O&M Manual/Data	For Materials or Equipment Specified in Section(s)
Building Finish & Appurtenances	07 24 13 – Polymer-Based Exterior Insulation and Finish System 07 61 13 – Metal Roofing 08 16 13 – Fiberglass Doors
HVAC Equipment	23 80 00 - HVAC - Equipment
Electrical Equipment	26 09 13 - Instrument Transformers and Meters 26 14 13 – Switchboards 26 22 00 – Low-Voltage Transformers 26 24 16 – Low-Voltage Panelboards 26 24 19 – Low-Voltage Motor Control 26 29 23 – Owner-Furnished Low-Voltage Adjustable Frequency Drives 26 43 13 – Surge Protective Devices (SPDs) 1000V or Less 26 50 00 – Lighting
Pipes, Pipe Fittings, and Valves	40 05 00 – Pipe and Pipe Fittings Basic Requirements 40 05 51 - Valves – Basic Requirements 40 05 64 - Butterfly Valves 40 05 66 - Check Valves
Instrumentation and Controls	40 75 00 - Process Liquid Analytical Measurement 40 90 00 - Instrumentation for Process Control – Basic Requirements 40 91 10 - Primary Meters and Transmitters 40 94 43 – Programmable Logic Controller (PLC) Control System 40 96 52 – Configuration Requirements Human Machine Interface (HMI) and Reports 40 97 00 – Control Auxiliaries 40 98 00 – Control Panels and Enclosures
Davit Cranes	41 22 23 - Hoists, Trolleys, and Monorails 43 05 21 – Common Motor Requirements
MLR Pumps	43 05 21 – Common Motor Requirements 43 21 00 - Pumping Equipment - Basic Requirements 43 25 13 - Pumping Equipment - Submersible Non-Clog
Anoxic Mixers	43 05 21 – Common Motor Requirements 46 41 00 - Mixers
Membrane Disc Diffusers	46 51 00 - Aeration Equipment - Basic Requirements 46 51 33 - Flexible Membrane Disc Diffusers

B. Timing of Submittals and Quantity Required:

1. Preliminary Operation and Maintenance Manual Submittals:
 - a. Paper Copies: Three copies, exclusive of copies required for Contractor’s use.
 - b. Electronic Documents: In accordance with Section 01 31 26 - Electronic Communication Protocols.
 - c. Submit to entity indicated in Section 01 33 00 – Submittal Procedures, by the earlier of: 90 days following approval of Shop Drawings and product data Submittals, or 14 days prior to starting training of operation and maintenance personnel, or 14 days prior to field quality control testing at the Site.

- d. Do not perform checkout, startup, and training without Engineer's acceptance of preliminary operation and maintenance data Submittals for the associated Work.
2. Final Operation and Maintenance Manual Submittals: Furnish final Submittal prior to Substantial Completion of the associated Work, unless submittal is required prior to an interim Milestone.
 - a. Paper Copies: Three copies, exclusive of copies required for Contractor's use.
 - b. Electronic Documents: In accordance with Section 01 31 26 - Electronic Communication Protocols.
 - c. Work will not be eligible for Substantial Completion until associated, required final operation and maintenance data Submittals are accepted by Engineer.
 - d. If Contractor (whether or not via Subcontractor or Supplier), revises program code or configuration files between acceptance of Submittal by Engineer and end of the Contract's correction period and Contractor's general warranty obligation, furnish updated program code and configuration files to Owner. Before modifying program code and configuration files after Substantial Completion, verify with facility manager that Owner- or facility manager modifications of program code or configuration files were incorporated into the modified files, subject to the provisions of this Section.

1.3 PAPER COPIES OF O&M MANUALS

A. Binding and Cover:

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy, as necessary.
2. Binders shall be not less than one inch wide and maximum of three inches wide. Binders for each copy of each volume shall be same size and color.
3. Binders shall be locking three-ring ("D"-ring) type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front and back of each volume.
4. Do not overfill binders.
5. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
6. Indicate the following information on cover of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS". For submittal of preliminary operation and maintenance data, include the word, "PRELIMINARY" in the title.
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is submitted, listed as "Volume [_____] of [_____]"; with appropriate volume-designating numbers filled in.
 - d. Name of Project and, when applicable, Contract name and number.
 - e. Name of building or structure, as applicable.
7. Provide the following information on spine of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS". For submittal of preliminary operation and maintenance data, include the word, "PRELIMINARY" in the title.
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, when more than one volume is submitted, listed as "Volume [_____] of [_____]"; with appropriate volume-designating numbers filled in.
 - d. Project name and building or structure name.

B. Pages:

1. Print pages in paper copies of operation and maintenance manuals on 30-pound (minimum) paper, 8.5-inch by 11-inch size.
2. Reinforce binding holes in each individual paper sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of manuals, reinforcing of pages within booklet or pamphlet is not required.
3. Furnish each page with binding margin not less than 3/4-inch wide.

4. Properly punch each paper page with holes suitable for associated binding. Provide not less than 3/8-inch of paper between outer edge of punched holes and edge of paper. Manuals with improperly punched holes will be returned to Contractor as unacceptable.
 5. In paper copies of manuals, each page in each copy shall be properly bound-through by the binder's rings or posts. Paper manuals where some pages are not so bound will be returned to Contractor as unacceptable.
- C. Drawings:
1. Bind into operation and maintenance manuals drawings, diagrams, and illustrations up to and including 11-inch by 17-inch size, with reinforcing and punched holes specified for paper pages.
 2. Drawings or sheets larger than 11-inch by 17-inch shall be:
 - a. Paper Copies: Neatly folded and inserted into clear plastic pockets bound into the manual. Neatly and permanently label each pocket with printed text indicating content and drawing numbers. Include not more than two drawings or sheets per pocket.
 - b. Electronic Documents Copies: Included in electronic file at appropriate location.
- D. Copy Quality and Document Clarity:
1. Provide original-quality copies. Documents in operation and maintenance manuals shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals with copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable.
 2. Clearly mark, using ink, to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished and cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.
- E. Organization:
1. Indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.4 ELECTRONIC DOCUMENTS O&M MANUALS

- A. Electronic Documents of Operation and Maintenance Manuals:
1. Each Electronic Document copy of operation and maintenance data shall include all information included in the corresponding paper copy.
 2. Submit Electronic Documents operation and maintenance data in accordance with Section 01 31 26 - Electronic Communication Protocols, and Section 01 33 00 - Submittal Procedures.
 3. File Format:
 - a. Unless otherwise required by Section 01 31 26 - Electronic Communication Protocols, or Section 01 33 00 - Submittal Procedures, operation and maintenance data Electronic Documents shall be "portable document format" (PDF) files.
 - b. Electronic Documents shall be electronically searchable upon delivery.
 - c. Electronic Documents shall not be password-protected and shall not be protected against Owner's or facility manager's copying and printing such files for Owner's or facility manager's use in operating and maintaining the facility.
 - d. Electronic Documents shall open to its first page.
 - e. Submit each operation and maintenance manual as a single Electronic Document file, unless file size is over-large, in which case divide into as few separate files, each with similar filename, as possible.
 - f. Within each Electronic Document, provide bookmarks for the following:
 - 1) Each chapter and subsection indicated in the corresponding printed copy document's table of contents.
 - 2) Each figure.

- 3) Each table.
- 4) Each appendix and attachment.

1.5 CONTENT OF OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance Manual Content – General:

1. Prepare each operation and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-constructed drawings as applicable, bills of materials, technical information, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
2. Provisions of this Article were written for equipment. Where operation and maintenance data are required for building products, such as finishes, openings, thermal and moisture protection, and similar items, comply with this Article to the extent practical and reasonable for the associated item.
3. Completeness and Accuracy:
 - a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
 - b. Operation and maintenance manuals shall be complete and accurate.
 - c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
4. Provide dividers and Include manufacturer's information, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where published documents, included in operation and maintenance data, pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
5. Identify each equipment item consistent with names and identification numbers shown or indicated in the Contract Documents, rather than manufacturer's model numbers.
6. Neatly type data not furnished in computer-printed text. Handwriting, except for strikeouts, arrows, and the like, is unacceptable.
7. Include copy of warranty in accordance with the Contract Documents, including Section 01 78 36 - Warranties.
8. Include copy of proposed service contract, when applicable.
9. When copyrighted material is used in operation and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

B. Differences Between Preliminary and Final Operation and Maintenance Manuals:

1. In preliminary operation and maintenance manuals, include flysheet or placeholder for information to be included in final operation and maintenance manual Submittal.
2. In final operation and maintenance manuals, include information such as the following, as applicable for the associated materials and equipment:
 - a. Equipment data that requires collection after startup, for example: (1) system and equipment balancing reports, including those for HVAC systems; and (2) final settings for electrical switchgear, automatic transfer switches, and circuit breakers; and (3) materials and equipment field testing results.
 - b. Equipment startup reports and Suppliers' field service reports (the latter on form in Section 01 75 00 - Checkout and Startup Procedures).

C. Initial Documents in Operation and Maintenance Manuals:

1. Table of Contents:
 - a. Provide table of contents in each volume of each operation and maintenance manual.
 - b. In table of contents and not less than once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identifying items is unacceptable.
 2. Equipment Record:
 - a. Provide "Equipment Record" section of operation and maintenance manual immediately following the table of contents. "Equipment Record" section is not required for operation and maintenance data for other than equipment (such as building materials and finishes).
 - b. Provide "Equipment Record" on forms included as this Section's Attachments 1, 2, and 3.
 - c. For instrumentation and control equipment, International Society of Automation (ISA) data sheets are acceptable in lieu of the forms included as this Section's Attachments 1, 2, and 3.
 - d. This Section's Attachments 1, 2, and 3 are available from Engineer as "fillable PDF forms".
 - e. Complete in detail each section of "Equipment Record". Merely referencing the associated equipment's operation and maintenance data for nameplate, maintenance, spare parts, lubricants, or other required information, is unacceptable.
 - f. For equipment or systems with multiple, separate components (for example, motor and gearbox), fully completed "Equipment Record" is required for each component.
 - g. Operation and maintenance data Submittals without complete and accurate "Equipment Record" sheets are unacceptable.
 3. Supplier's Field Service Reports:
 - a. Include in final operation and maintenance manuals copies of associated Supplier's field services reports in accordance with Section 01 75 00 - Checkout and Startup Procedures.
 - b. Include Supplier's completed field service reports in operation and maintenance manual in section immediately following "Equipment Record" section.
- D. Operation and Maintenance Instructions:
1. Safety Considerations:
 - a. Submit written descriptions of safety considerations relating to operation and maintenance procedures for materials and equipment.
 - b. Describe safety devices and alarms provided with materials and equipment and proper operation and use.
 - c. Indicate procedures for proper, safe operating and maintenance of materials and equipment furnished, including manufacturer's recommended personal protection equipment, apparatus, and devices not furnished under the Contract.
 - d. Describe recommended safety-related training for personnel operating and maintaining the subject materials or equipment.
 - e. Include in appendix to operation and maintenance manual manufacturers' relevant "safety data sheets" (SDS), formerly "material safety data sheets" (MSDS).
 - f. Engineer's review of operation and maintenance data expressly does not extend to adequacy, completeness, and accuracy of SDS or other safety and protection practices and procedures indicated in the operation and maintenance data.
 2. Operation:
 - a. Include in operation and maintenance data Submittals complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; and regulation and control. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

- b. Include pre-startup instructions and checklists and complete startup instructions for each material and equipment item.
 - c. Indicate recommended operating instructions for all operating modes and conditions, with associated recommendations for safe operation.
 - d. Explain available controls and instrumentation and associated function(s).
 - e. Indicate required shutdown checklists and procedures for: normal shutdown, emergency shutdown, and long-term shutdowns.
 - f. Troubleshooting instructions.
3. Maintenance – General:
- a. Include in operation and maintenance data complete, written instructions for necessary and recommended maintenance, including mechanical maintenance and electrical/instrumentation and controls maintenance, as applicable.
 - b. Include in operation and maintenance data complete instructions for necessary assembly, disassembly, installation, re-installation, storage, and shipping for materials and equipment.
 - c. Tools: Include list of required maintenance tools and equipment.
 - d. Spare Parts and Extra Materials:
 - 1) Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
 - 2) Submit manufacturer’s recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
 - 3) Also refer to this Article’s provision, “Bills of Materials”, below, for additional requirements regarding ordering replacement parts.
4. Routine and Preventative Maintenance:
- a. Submit complete, detailed, written instructions for routine and preventive maintenance including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
 - 1) Written explanations with illustrations for each routine and preventive maintenance task such as inspection, adjustment, anchor bolt torque checks, lubrication, calibration, cleaning, replacement of filters, and the like.
 - 2) Recommended schedule for each routine and preventive maintenance task.
 - 3) Lubricants:
 - a) Provide lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
 - b) Table of alternative lubricants.
5. Major Maintenance:
- a. Include detailed, written instructions and illustrations for required periodic (non-routine, non-preventative) maintenance.
 - b. Indicate relative level of training and expertise required to perform such maintenance and recommended tools and equipment.
6. Special Maintenance:
- a. Include maintenance instructions for long-term shutdowns and storage.
- E. Bills of Materials:
- 1. Include in operation and maintenance manuals complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:

2. Manufacturer's name, physical address, telephone number, internet website address.
 3. Manufacturer's local service representative's or local parts supplier's name, physical address, telephone number, internet website address, and e-mail addresses.
 4. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 5. For each part or piece include the following information:
 - a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - b. Part name or description.
 - c. Manufacturer's part number.
 - d. Quantity of each part used in each assembly.
 - e. Current unit price of the part at the time the operation and maintenance manual is submitted. Price list shall be dated.
- F. Record Copy of Shop Drawings, Product data, and Other Previously Approved and Accepted Submittals:
1. Submit original-quality copies of each approved and accepted (as applicable) Shop Drawing, product data Submittal, written results of source quality control activities, and other Submittals, updated to indicate as-installed condition. Do not include prior Submittals that were not approved or were not accepted. Reduced drawings are acceptable only when reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
- G. Electrical Schematics, Diagrams, and Information:
1. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
 2. Include as-constructed drawings of layouts of electrical panels (such as switchgear and motor control centers) and control panels.
- H. NFPA 70 (National Electric Code) Documentation:
1. Include in operation and maintenance manuals for electrically-powered equipment documented calculations of: (1) arc-fault current, equipment available fault current and (2) short-circuit current rating (SCCR), provided as part of equipment Submittals.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The following, bound after this Section's "End of Section" designation, are part of this Section:
1. Attachment 1 - Equipment Data and Spare Parts Summary form (one page)
 2. Attachment 2 - Recommended Maintenance Summary form (one page)
 3. Attachment 3 - Lubrication Summary form (one page)

END OF SECTION



Equipment Data and Spare Parts Summary

Project Name		Ketchum / SVWSD WRF Aeration Upgrades		Specification Section:	
Equipment Name				Year Installed:	
Project Equipment Tag No(s).					
Equipment Manufacturer				Project/Order No.	
Address				Phone	
Website		Web Site		E-mail	
Local Representative/Service Center					
Address				Phone	
Website				E-mail	

MECHANICAL NAMEPLATE DATA

Equip.			Serial No.		
Make			Model No.		
ID No.	Frame No.	HP	RPM	Cap.	
Size	TDH	Imp. Size	CFM	PSI	
Other:					

ELECTRICAL NAMEPLATE DATA

Equip.			Serial No.					
Make			Model No.					
ID No.	Frame No.	HP	V.	Amp.	Hertz	PH	RPM	SF
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating	
Other:								

SPARE PARTS PROVIDED PER CONTRACT

Part No.	Part Name	Quantity

RECOMMENDED SPARE PARTS

Part No.	Part Name	Quantity

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Lubrication Summary

Equipment Description	Project Equip. Tag No(s).
-----------------------	---------------------------

Lubricant Point							
Lubricant Type	1	Manufacturer	Product	AGMA #	SAE #	ISO	
	2						
	3						
	4						
	5						
Lubricant Point							
Lubricant Type	1	Manufacturer	Product	AGMA #	SAE #	ISO	
	2						
	3						
	4						
	5						
Lubricant Point							
Lubricant Type	1	Manufacturer	Product	AGMA #	SAE #	ISO	
	2						
	3						
	4						
	5						
Lubricant Point							
Lubricant Type	1	Manufacturer	Product	AGMA #	SAE #	ISO	
	2						
	3						
	4						
	5						
Lubricant Point							
Lubricant Type	1	Manufacturer	Product	AGMA #	SAE #	ISO	
	2						
	3						
	4						
	5						
Lubricant Point							
Lubricant Type	1	Manufacturer	Product	AGMA #	SAE #	ISO	
	2						
	3						
	4						
	5						

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SECTION 01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General requirements for warranties required in the various Specifications.
 2. Provisions addressing:
 - a. Suppliers' standard warranties.
 - b. Suppliers' special or extended warranties.
 - c. Implied warranties.
 - d. Commencement and duration of warranties.

1.2 SUBMITTALS

- A. General:
1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or Submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such Submittal is required in the Specifications for the material.
 2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
 3. Supplier's warranties shall be specifically endorsed to Owner, Contractor, and the entity purchasing the item (if other than Contractor) by the entity issuing such warranty.
 4. Submit Suppliers' standard warranties and special warranties as Submittals in accordance with the Schedule of Submittals accepted by Engineer.

1.3 CONTRACTOR'S GENERAL WARRANTY AND CORRECTION PERIOD OBLIGATIONS

- A. Contractor's General Warranty and Guarantee: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- B. Contractor's Warranty of Title: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- C. Correction Period: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

1.4 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT

- A. Warranty Types:
1. Required by the General Conditions:
 - a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the Contract's correction period.
 - b. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty and guarantee, nor does such affect or limit Contractor's performance obligations under the correction period.
 2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to the entities indicated in this Specifications Section's Article 1.2.
 3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to Owner and other beneficiaries (if any) of such warranty. Where the Contract Documents indicate

specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.

- B. Requirements for Special Warranties:
 - 1. Submit written special warranty document that contains appropriate provisions and identification, ready for signature by material or equipment manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section. Submit draft warranty with Submittals required prior to fabrication and shipment of the item from the Supplier's facility.
 - 2. Manufacturer's Standard Form: Modified to include Project-specific information and properly signed by product manufacturer and other entities as appropriate.
 - 3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly signed by item manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section, using the required form.
 - 4. Refer to the Specifications for content and requirements for submitting special warranties.

1.5 IMPLIED WARRANTIES

- A. Warranty of Title and Intellectual Property Rights:
 - 1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
 - 2. Provisions on intellectual property rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Warranty of Merchantability:
 - 1. Notwithstanding any other provision of the Contract to the contrary, implied warranties of merchantability required by Laws and Regulations apply to the materials and equipment incorporated into the Work.
- C. Warranty of Fitness-for-Purpose:
 - 1. Implied warranty of fitness-for-purpose for materials and equipment to be incorporated into the Work, for which specific material or features are indicated in the Contract Documents, is hereby disclaimed by Owner and Contractor.
 - 2. When Supplier is aware of, or has reason to be aware of, specified materials or features of the Work that are contrary to the intended use, purpose, service, application, or environment in which the material or item will be used, submit request for interpretation in accordance with Section 01 26 00 - Contract Modification Procedures. Where appropriate, such request for interpretation shall indicate the apparent discrepancy and propose appropriate, alternative materials or equipment.

1.6 COMMENCEMENT AND DURATION OF WARRANTIES

- A. Commencement of Warranties:
 - 1. Contract correction period and Contractor's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 - 2. Suppliers' standard warranties and special warranties commence running on the date that the associated item is certified by Engineer as substantially complete in accordance with the Contract Documents. In no event shall special warranties commence running prior to Engineer's review and acceptance of special warranty Submittal for the item.
 - 3. Implied warranties commence in accordance with Laws and Regulations.
- B. Duration of Warranties:
 - 1. Duration of correction period is set forth in the General Conditions, as may be modified by the Supplementary Conditions.
 - 2. Duration of Contractor's general warranty and guarantee is in accordance with Laws and Regulations.

3. Duration of Suppliers' standard warranties is in accordance with the applicable standard warranty document accepted for the Project by Engineer.
4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.
5. Duration of implied warranties shall be in accordance with Laws and Regulations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 81 10
WIND AND SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. The following types of design criteria for the Project, including Work designed by (a) Engineer and (b) delegated design professional(s) retained by Contractor, Subcontractor, or Supplier and submitted for Engineer's approval under the Contract:
 - a. Wind loading.
 - b. Seismic.
 - c. Snow loading.
- B. Scope:
1. Certain Work, expressly indicated, shall be designed, fabricated, and installed in accordance with the wind, snow, and seismic requirements of this Section and Laws and Regulations (including applicable building codes).
 2. This Section applies to all the Work. Where wind, snow, and seismic design criteria indicated in this Section conflict with wind, snow, and seismic design criteria set forth elsewhere in the Contract Documents, the more-stringent loading and requirements shall govern, unless clarified in writing by Engineer. Obtain Engineer's written interpretation or clarification of conflicts prior to performing the subject design and other associated Work.
 3. Contractor shall provide all labor, materials, equipment, tools, professional services, and incidentals to provide wind, snow, and seismic design for the Work.
 4. Such Work includes, but is not necessarily limited to, the following:
 - a. Anchorage of mechanical and electrical equipment and systems.
 - b. Anchorage of supports for piping, electrical conduits and cable trays, and similar Work.
 - c. Work requiring delegated professional design for the final, completed Project.
- C. Related Requirements: Include but are not necessarily limited to:
1. Section 01 35 73 - Delegated Design Procedures.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate all wind, snow, and seismic design required of Contractor for the Work.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Society of Civil Engineers / Structural Engineering Institute (ASCE/SEI):
 - a. 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
 2. When referenced standards conflict, the most-stringent governs, unless specifically indicated otherwise in the Contract Documents or unless approved otherwise in writing by the Engineer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following as part of the Submittals required in Divisions 02-49 Specifications that require wind, snow, and seismic delegated designs:
1. Delegated Design Professional's "Instruments of Service" Submittals:
 - a. Delegated design professional's "certification of compliance" required by Section 01 35 73 - Delegated Design Procedures, regarding structural calculations:
 - 1) Indicate compliance with performance and design criteria indicated in the Contract Documents.

- 2) Indicate compliance with specific reference standards indicated in the building code and the associated Contract Documents.
 - 3) Indicate other information required for “certification of compliance” in accordance with Section 01 35 73 - Delegated Design Procedures.
- B. Informational Submittals: Submit the following as part of the Submittals required in Divisions 02-49 Specifications that require wind , snow, and seismic delegated designs:
1. Delegated Design Professional’s Calculations:
 - a. Such calculations shall include delegated design professional’s seal, signature, and date and are to indicate the following, which will not be reviewed by Engineer except for the limited purposes indicated in Section 01 35 73 - Delegated Design Procedures:
 - 1) Indicate basis of design and lateral analysis as necessary and required to derive each loading and to indicate system stability, including compatibility of deflections and compatibility with allowable soil parameters, as applicable.
 - 2) Indicate design load to each connection to structure (where connection will attach to or interface with, or supported by, elements designed by Engineer).
 - 3) Indicate and provide complete lateral load resisting system that transfers all wind and seismic loads through load path to ground.
 2. Shop Drawings and Product Data Approved by Delegated Design Professional: The following are required but will be reviewed by Engineer only for the limited purposes indicated in Section 01 35 73 - Delegated Design Procedures:
 - a. Shop Drawings showing and indicating proposed wind , snow, and seismic controls Work designed by delegated design professional.
 - b. Product data showing and indicating proposed wind , snow, and seismic controls Work designed by delegated design professional.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN CRITERIA FOR WIND, SNOW, AND SEISMIC

- A. This Article 2.1 applies to wind , snow, and seismic design criteria.
- B. Design by delegated design professional retained by Contractor, Subcontractor, or Supplier shall comply with:
 1. Performance and design criteria indicated in the applicable Contract Documents, including this Section.
 2. Laws and Regulations, including applicable building code.
 3. Applicable reference standards indicated in the Contract Documents.
- C. Risk Category: III.
 1. Design in accordance with building code load combinations for, at Contractor’s option, either service level or factored level.
 2. Mechanical and electrical equipment and systems loads are dead loads, except where mechanical elements, such as piping and tanks, are filled with material such as liquid or slurry (in which case the dead load of the pipe’s or vessel’s contents shall also be included).

2.2 WIND DESIGN CRITERIA

- A. Wind Design Load Criteria:
 1. Design Wind Speed: $V_{ult} = 110$ miles per hour.
 2. Exposure Category: C.
 3. Topographic Factor: $K_{zt} = 1.0$.
 4. Wind Importance Factor: $I_w =$ Not applicable.
 5. Building description for wind design is Open, Enclosed,,] Partially Open, or Partially Enclosed.
- B. Wind forces must be resisted by direct load transfer through fasteners to wind-resisting elements. Do not use connections that employ friction to transfer wind forces.

2.3 SEISMIC DESIGN CRITERIA

- A. Seismic Design Load Criteria:
 - 1. Design spectral acceleration at short period: $S_{DS} = 0.532$.
 - 2. Design spectral acceleration at 1-second period: $S_{D1} = 0.278$.
 - 3. Importance Factor: $I_e = 1.100$.
 - 4. Seismic Design Category: D_1 .
 - 5. Component or system amplification factor, (a_p) and component response modification factor (R_p): In accordance with ASCE 7-16, Tables 13.5-1 and 13.6-1.
 - 6. Component Importance Factor:
 - a. All Other Components: $I_p = 1.00$.
- B. Seismic forces must be resisted by direct load transfer through fasteners to seismic-resisting elements. Do not use connections that employ friction to transfer seismic forces.
- C. Snow Design Load Criteria:
 - 1. Design ground snow load: $p_g = 120$ psf.
 - 2. Design exposure factor: $C_e = 1.0$
 - 3. Design slope factor: $C_s =$
 - 4. Design thermal factor: $C_t = 1.0$
 - 5. Importance Factor: $I_s = 1.10$.
 - 6. Minimum snow load for low-slope roofs: p_m 100 psf
 - 7. Minimum flat roof snow load: $p_f = 100$ psf
 - 8. Design considerations for partial loading, unbalanced snow, snow drift in the vicinity of adjacent structures or projections, sliding snow, and other applicable factors shall be considered at locations required by Laws and Regulations, including applicable building codes.
 - 9. In no event shall snow design load criteria or minimum snow load be less than required by authority having jurisdiction.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 81 33
CYBER SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. General requirements for cyber security measures applicable to all the Work.
 2. Requirements to furnish Owner copy of code and configuration files.
 3. Supplier and all other parties providing parts and services under this contract are subject to these conditions. This includes hardware and software, licensing, intellectual equipment, patent restrictions and use, copyright, and similar equipment, systems, and appurtenances covered under this Section.
 4. Requirements for vendors, suppliers and / or Contractor-furnished equipment with microprocessor-based equipment including:
 - a. Providing full and unrestricted use by the Owner for equipment supplied under this contract including access, review, updates, and modification of software code, firmware and configurations of PLCs, PACs, RTUs, HMIs, DDCs, OITs, or any other microprocessor-based equipment.
 - b. Allowing Owner to transfer to designated agents the right to perform this work on their behalf.
 - c. Furnishing software source code for the system supplied.
 - d. Coordinate with Owner to remove default usernames and passwords, to remove contractor passwords at time of system acceptance, and turn-over of all passwords utilized in the system.
 5. Requirements for vendors, suppliers and / or Contractor-furnished items for furnishing program code, passwords, keys, and configuration files upon project milestones and at substantial completion.
- B. Scope:
1. This Section indicates cyber security requirements applicable to all equipment, controls, devices, and other items furnished to Owner and Owner-furnished items modified as part of the Work, containing microprocessor based systems and that will be, can be (in the future), or may potentially be (in the future) connected to Owner's network or the internet.
 2. This Section applies regardless of whether the subject items were furnished or modified by Contractor, Subcontractor, or Supplier of any tier.
 3. By furnishing equipment, controls, devices, or other items for the Work, Suppliers and Subcontractors, if any, are bound by this Section's requirements to same extent Contractor is so bound.
 4. Supplier agrees to assist in cybersecurity basic hygiene practices as dictated by best practices included in this section, government regulation at time of bid, and as provided by the Owner's cyber security team. At a minimum, the supplier will coordinate with Owner and assign IP addresses and subnet masking, utilized of managed switches with unused ports disabled, provide all equipment with latest firmware at time of field installation.
 5. All equipment supplied will be current and not be obsolete or subject to a manufacturer's end-of-life notice of less than 2 years after startup.
 - a. Provide any notices of manufacturer's end-of-life notices for all equipment at the time of submittal for approval of equipment. This shall include searching equipment websites during the submittal process to ensure the products are not nearing end of life.
 6. At Substantial Completion, the Owner shall be granted full use of equipment and services provided by equipment and its associated automation under this Section and shall include:
 - a. Full access and use of supplied software within any equipment supplied including PLCs, OIT, networking and communications equipment, gateways, and HMI code

(including fully documented source code), internal function blocks or code shall be ceded to the Owner for their exclusive use at the location(s) of the equipment. These rights shall transfer to future locations or owners.

- b. Right to modify, enhance or make changes to the equipment as deemed necessary or desired by the Owner, including hardware, software, networking settings, passwords or other information or settings that the Owner may change for maintenance, upgrade, or cybersecurity reasons.
 - c. Full release of claims to Intellectual Equipment, Trade Secrets, or Sensitive Information as supplied with this equipment as may be claimed by the supplier or any of their subcontractors, subconsultants and the like as regards equipment or services provided herein to the Owner.
 - d. No provisions for Non-Disclosure Agreements (NDAs) or other restrictions to restrict or prevent the Owner from obtaining or using information, licenses, electronic data, software are allowable.
7. The supplier shall furnish software source code for the equipment supplied. The code or any part of the system may not be hidden or protected by encryption, passwords, or other means without providing these passwords or access to the Owner's designated personnel.
 8. The supplier shall take measures to limit the distribution of information on Owner's system information to the minimum personnel required. The supplier shall not publish to public facing media this information at any time.

C. Related Requirements:

1. Section 01 31 26 - Electronic Communication Protocols.
2. Section 01 33 00 - Submittal Procedures.
3. Section 01 75 00 - Checkout and Startup Procedures.
4. Section 01 78 36 - Warranties.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Comprehensive asset inventory of all networked components:
 - a. Provide in Excel spreadsheet format.
 - b. Submit in accordance with the Requirements of 01 31 26 - Electronic Communication Protocols.
 - c. Include:
 - 1) Device ID.
 - 2) Manufacturer.
 - 3) Model Number.
 - 4) Serial Number.
 - 5) MAC Address.
 - 6) IP Address.
 - 7) Device Use description.
 - 8) Firmware Version.
2. Network Diagrams:
 - a. Provide in both AUTO CAD and PDF formats.
 - b. Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of information contained in Network Diagrams.
 - c. Logical Network Diagram(s):
 - 1) Depict information flow through network(s), and include:
 - a) Major network devices, subnets, and VLANs.
 - b) Include all wireless communication devices.
 - c) Include the following information for each networked device:
 - (1) Device ID.
 - (2) Device description.
 - (3) Manufacturer/model number.
 - (4) MAC address.

- (5) IP address.
 - (6) Ports and Protocols
 - d. Physical Network Diagram(s):
 - 1) Show all network components, ports, protocols, connections and cables.
 - a) Include all wireless communication devices.
- B. Close-out Submittals: Submit the following:
 - 1. Password Turn-over: Coordinate with Owner to securely transmit directly to Owner list of usernames and passwords applied to replace factory and Supplier's defaults.
 - 2. Network-Capable Device Asset Inventory: Furnish, as unlocked, editable Microsoft Excel file listing all network-capable devices furnished or modified under this Section. List shall include:
 - a. Device name.
 - b. Device location (in network and physical location).
 - c. Manufacturer name.
 - d. Product name and model designation.
 - e. Manufacturer's serial number on device.
 - f. Mac address (when device is IP-addressable).
 - g. IP address (when device is IP-addressable).
 - h. Edition of revision number of installed firmware or operating system.
 - 3. Backup of Application Software: Furnish directly to Owner Electronic Document copy of each software application and equipment configuration file necessary for Owner's Facility Manager to restore functionality of system after a system disaster or other such event.
 - a. Software source code for all PLCs, HMIs, OITs and other devices.
 - b. Configuration files, encryption information and other sensitive information for the full project scope.
 - 4. Work will not be eligible for final payment until all closeout submittals, including required program code and configuration submittals, are received and accepted by Engineer.
- C. Timing: Submittals will be required at the following project stages:
 - 1. Network Diagrams and Asset Inventory – with control panel submittals.
 - 2. Draft Software and Configuration Files, and As-Manufactured Network Diagrams – Available at Factory Acceptance Testing.
 - 3. All documents available on-site upon equipment delivery to the project site.
 - 4. All documents contained within Operation & Maintenance manuals.
 - 5. Close-Out submittals at project closeout.

1.3 COPIES OF PROGRAM CODE AND CONFIGURATION FILES

- A. Copies of Program Code and Configuration Files – General:
 - 1. Submit as Electronic Documents only. Paper Submittals are not required for program code and configuration files.
 - 2. Files to be securely transferred with limited distribution as requested by the Owner or supplier to protect sensitive information. Provide proof of file transfer for submittal record purposes.
 - 3. In accordance with the Contract Documents, following Substantial Completion, Owner and facility manager shall have right to: (a) modify program code and configuration files, (b) update software and firmware, (c) revise system security settings, such as passwords, IP addresses, and other security settings, and (d) implement related modifications, without restriction or interference from Contractor, Subcontractor, Supplier, and others.
 - 4. Owner and facility manager agree to use program code and configuration files only with Owner's facilities, as may be transferred to Owner's successors and assigns.
 - 5. Owner and facility manager will not be subject to any Supplier-requested non-disclosure agreement that is not part of the Contract Documents.
 - 6. Engineer agrees to not distribute program code and configuration files obtained under the Project, except in exchanging such files with Owner, facility manager, or their successors

and assigns. Engineer will not be party to any Supplier-requested non-disclosure agreement.

B. Configuration Files:

1. Submit copies of system configuration prepared for the Project, such as setpoints for programmable controllers, facility SCADA display configurations, and similar configuration files.
2. Files to be securely transferred with limited distribution as requested by the Owner or supplier to protect sensitive information. Provide proof of file transfer for submittal record purposes.
3. Submit as separate files configuration files for each separate control and monitoring device for which configuration files are furnished. Clearly distinguish the device(s) associated with each file.
4. Contractor (including Subcontractors and Suppliers) is not responsible for configurations and control setpoints subsequently changed by Owner, facility manager, or others for whom either is responsible, not in accordance with Supplier's written recommendations and operation and maintenance instructions.

C. Program Code:

1. Submit copies of program code for programmable logic controllers (PLC), human-machine interfaces (HMI), operator interface terminals (OIT), and other programmable controllers, subject to the following:
 - a. Submit for all PLCs, HMI, OITs, and other programmable controllers furnished as part of the Work, and where Owner's existing devices were modified as part of the Work, regardless of whether such program code is manufacturer's standard, or developed specifically for the Project, or a combination of manufacturer's standard program code and Project-specific program code. Contractor and associated Subcontractors and Suppliers are not responsible for program code modifications made by Owner or facility manager (or third parties retained by Owner or facility manager) that result in improper operation of materials, equipment, or systems or that invalidate applicable warranties and manufacturer's recommended operating instructions.
 - b. Third-party, licensed, commercially available software (such as, but not limited to, Microsoft operating system software sold at retail, and commercial SCADA system software platforms, PLC programming software) is excluded from requirements of this Article. Furnish copies of commercially available, licensed, third-party software, where required, in accordance with the Contract Documents.
2. Submit annotated copies of complete PLC software programs:
 - a. In native-format file including all applicable formats (ladder logic, function block diagram, sequential function chart, instruction list, structured text).
 - b. In PDF-format file with fully annotated PLC code that can be read without the native configuration and programming environment on electronic media (DVD or USB drive).
3. Format Requirements:
 - a. For ladder diagram logic, include complete cross-referencing of all logic elements. Annotate all elements with clearly understandable tags or descriptive labels.
 - b. For function block diagram, label each function block with understandable tags or descriptive labels. Describe purpose and action of each function block.
 - c. For sequential function chart, include extensive comments for each step to describe program step function.
 - d. For instruction list and structured text, include extensive comments for each program line to describe program line function.
4. Submit complete programmable logic controller listing of all input/output address assignments, tag assignments, and pre-set constant values, with functional point descriptions.
5. Submit complete manufacturer's program code manuals.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 CONTRACTOR ACCESS TO INSTALLED EQUIPMENT

- A. Unless specifically included within the plans and specifications, remote access appliances for interaction with programmable devices will not be accepted during construction or operation. Where remote access is required, vendor shall submit RFI for allowable methods and describe the specific remote access needs (i.e., programming, view only data, emergency support) and coordinate with Owner/Engineer on acceptable solution which achieves the owner's cybersecurity risk tolerance.

3.2 CONTRACTOR ACCESS TO CLIENT NETWORK WHILE ON-SITE

- A. Contractor laptops utilized for programming and startup of programmable devices will not be allowed to connect to Owner's programmable device network.
- B. Owner cybersecurity requirements do not allow for contractor laptops to be connected to networks or devices at any time, coordinate with owner to request use of owner provided laptop at least 4 weeks prior to site activities.

3.3 CLOSEOUT ACTIVITIES:

- A. Update firmware of programmable devices to Supplier's current version at time of Substantial Completion.
- B. Usernames and Passwords:
 - 1. Change Supplier's default usernames and passwords in coordination with requirements of Owner's or facility manager's (as applicable) personnel, reference submittals section for password submission requirements.
 - 2. Remove each username and password established or used by Contractor, Subcontractor, or Supplier prior to Substantial Completion of equipment or system.
- C. Programmable Operator Interface Terminals (OIT) and Other Graphical Interface Terminals:
 - 1. For equipment that supports multiple levels of security, configure the following security levels:
 - a. View.
 - b. Operate.
 - c. Supervisor.
 - d. Administrator.
 - 2. For equipment that supports only view/operate levels of security, provide password protection and furnish directly to Owner or facility manager (as applicable) passwords necessary to operate functions.
 - 3. Coordinate directly with Owner and facility manager passwords and furnish password turn-over Submittal required in this Section's "Submittals" Article.

END OF SECTION

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DIVISION 02

EXISTING CONDITIONS



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SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General provisions applicable to all demolition and removals.
 - 2. Civil/site demolition and removals.
 - 3. Architectural and structural demolition and removals.
 - 4. Mechanical demolition and removals
 - 5. Electrical demolition and removals.
 - 6. Disposal of demolition debris, materials, and equipment.
- B. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, tools, and incidentals as shown, specified and required for demolition, removals, and disposal Work.
 - 2. The Work under this Specifications section includes, but is not necessarily limited to:
 - a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of structural concrete, walls, doors, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical systems and equipment, sidewalks, and similar existing materials, equipment, and items.
 - b. Demolition and removal of all above-grade piping and facilities and Underground Facilities underneath, building(s) and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are shown or indicated as to remain.
 - 3. Demolitions and removals indicated in other Specifications sections shall comply with requirements of this Specifications section.
 - 4. Perform demolition Work within areas shown or indicated.
 - 5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.
- C. Related Requirements:
 - 1. Section 31 10 00 - Site Clearing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Fire Protection Association (NFPA):
 - a. 241, Safeguarding Construction, Alteration, and Demolition Operations.
- B. Regulatory Requirements:
 - 1. Demolition, removals, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T – Demolition), and all other Laws and Regulations.
 - 2. Comply with requirements of authorities having jurisdiction.
- C. Qualifications:
 - 1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
 - 2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber(s) legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Comply with Section 01 14 16 - Coordination with Owner's Operations.
 - 2. Review procedures under this and other Specifications sections and coordinate the Work that will be performed with or before demolition and removals.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Procedure Submittals:
 - a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
 - 1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
 - 2) Other proposed procedures as applicable.
 - 3) Equipment proposed for use in demolition operations.
 - 4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
 - 5) Planned demolition operating sequences.
 - 6) Detailed schedule of demolition Work in accordance with the Schedule accepted by Engineer.
 - 2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Specifications Section.
 - 3. Field Quality Control Test Results:
 - a. Results of megger-testing of existing motors to remain Owner's property.
 - 4. Qualifications Statements:
 - a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
 - b. Name and qualifications of entity performing plumbing removals,

1.5 SITE CONDITIONS

- A. Owner makes no representation of condition or structural integrity of area(s) to be demolished or where removals are required by the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Notification:
 - 1. Not less than 48 hours prior to commencing demolition or removal, advise Engineer in writing of planned start of demolition Work. Do not start removals without permission of Engineer.
 - 2. Where demolition or removals has potential to affect adjacent properties, occupants, streets, or other public thoroughfare, transportation facilities, and utilities, furnish required notices to owners and occupants of properties, buildings, and structures that may be affected by the demolition of removal.
 - 3. In accordance with Laws and Regulations, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.
 - 4. Submit to Engineer copies of notices furnished to adjacent property owners, occupants, and authorities having jurisdiction.

- B. Protection of Adjacent Areas and Facilities:
 1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties unless allowed by the Contract Documents otherwise allowed in writing by Owner.
 2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
 3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removals work in the subject area is complete or until other Work requires removal of temporary partitions.
 4. Provide appropriate temporary barriers, lighting, sidewalk sheds, and other necessary protection.
 5. Repair damage to facilities that are to remain which such damages results from Contractor's operations.

- C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, perform the following:
 1. Should unforeseen, unknown, or incorrectly shown or indicated Underground Facilities be encountered, Contractor responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
 2. Sanitary Sewerage: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
 3. Storm Water Sewerage: Existing storm water system shall remain in place until demolition of existing building or structure is complete. Upon completing demolition, cut and cap storm sewerage at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities in accordance with the Contract Documents.
 4. Water Piping and Related Facilities: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished. Ensure compliance with Laws and Regulations regarding water quality.
 5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; compressed air; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
 6. Shutdown of utility services shall be coordinated by Contractor, assisted by Owner as required relative to contacting utility owners.

- D. Remediation:
 1. If unanticipated Hazardous Environmental Condition is believed to be encountered during demolition and removals, comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

3.2 DEMOLITION - GENERAL

- A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.

- B. Pollution Controls:
 1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level.

2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
 3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and Section 01 74 00 - Cleaning.
- C. Explosives:
1. Explosives are not allowed at the Site. Do not use explosives for demolition and removal Work.
- D. Comply with Section 01 73 29 - Cutting and Patching and NFPA 241.
- E. Building or Structure Demolition and Removals:
1. Unless otherwise approved by Engineer, proceed with demolition from top of building or structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
 2. Demolish concrete and masonry in small sections.
 3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
 4. Break up and remove foundations, mats, and slabs-on-grade unless otherwise shown or indicated as remaining in place.
 5. Temporary Bracing and Supports:
 - a. Provide temporary bracing and supports sufficient to maintain safety, stability, and resist all loads to which the structure may be subject during demolition and removals, until entirety is permanently removed or permanently stabilized.
 - b. Temporary bracing and supports shall be sufficient for associated dead load, live load, transient loading, and dynamic loads such as wind, seismic, and other loads to which the temporary bracing or support may be subject.
 - c. Where appropriate, retain a professional structural engineer, duly licensed and registered in the same jurisdiction as the Site, to design temporary bracing and supports.
- F. Salvage and Ownership:
1. Materials and equipment to remain Owner's property shall be:
 - a. Carefully removed and appropriately handled by Contractor to avoid damage and invalidation of warranties in effect. Brace motors attached to flexible mountings until reinstallation or delivery to Owner's storage location. Fully remedy to pre-construction condition or replace items damaged during removal or handling by Contractor.
 - b. Removed as functional units, together with all appurtenances required for operation.
 - c. Cleaned, listed, and tagged for storage.
 - d. Protected from damage.
 - e. Delivered to designated storage location at the Site or other site indicated in the Contract Documents, at place designated by Engineer or Owner.
 2. Items to be and delivered to Owner are as indicated in Table 02 41 00-A.

Table 02 41 00-A – Items to be Salvaged

Equipment Name/ Designation	Equipment Location	Deliver to Owner's Location
Aeration Basin Sump Pumps	Aeration Basin 03, Aeration Basin 04	Control Building
Existing B-302 and B-303 Isolation Valves	Blower Room (Blower Building)	Relocate as shown in Drawings
Aeration Blower B-303	Blower Room (Blower Building)	Relocate as shown in Drawings
AB Sump Pump Davit Cranes	Aeration Basin 03, Aeration Basin 04	Control Building

Equipment Name/ Designation	Equipment Location	Deliver to Owner's Location
Demolished Cable/Wiring	All work areas	Control Building

3. Preparation of Owner’s existing equipment for storage:
 - a. Where appropriate, identify each component with markings or tags to indicate its position in the assembly and the assembly of which it is part.
 - b. Place small parts in appropriate, durable boxes and clearly mark contents on the outside of box or container.
 - c. Remove oil from oil-lubricated bearings and gear boxes and replace with storage oil.
 - d. Grease grease-lubricated bearings.
 - e. Replace breather plugs with solid plugs.
 - f. Megger-test motor windings: Attach report of the test results to the associated motor and submit copy to Engineer.
 - g. Attach unit to suitable crate bottom.
 - h. Enclose unit in polyethylene film and seal all seams and the film to the base of the unit with tape.
 - i. Construct crate of wood slats around top and sides of unit.
 - j. Attach permanent instruction tag to outside of crate stating “This unit has been prepared for storage. Replace oil, vent plugs, and lubricant in accordance with manufacturer's instructions before start-up.”

G. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by Engineer.

3.3 STRUCTURAL REMOVALS

- A. Remove structures to lines and grades shown or indicated, unless otherwise directed by Engineer. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at Contractor’s risk and expense and such excess removals shall be reconstructed to satisfaction of Engineer without additional cost to Owner.
- B. Recycling and Reuse of Demolition Materials:
 1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless otherwise approved by Engineer.
 2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.
- C. After removing concrete and masonry walls or portions thereof, mats, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.
- D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
 1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
 2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.

3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 inches below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
 4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.
- E. Removal of Anchorages and Protruding Metals:
1. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, and where existing metals (and to be removed) protrude from concrete, remove the anchors and other metal to not less than 1.5 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface.
 2. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by Engineer.
- F. Jambs, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.
- G. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Specifications section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

- A. Mechanical demolition and removal Work includes dismantling and removing existing:
1. Piping systems and ductwork systems.
 2. Mechanical equipment and appurtenances.
 3. Mechanical elements of instrumentation and control systems, such as sensors and transmitters and similar items.
 4. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 73 29 - Cutting and Patching; Specifications sections in which requirements for coordination with Owner's operations are indicated; and applicable Specifications of Division 21 - Fire Suppression, Division 22 - Plumbing, Division 23 - Heating, Ventilating, and Air Conditioning, Division 40 - Process Interconnections, and others as applicable.
 5. Mechanical removals as required herein apply to systems exposed to view, hidden from view, and Underground Facilities. Mechanical removals may require work in spaces that may be classified confined spaces.
- B. Life-Safety Systems:
1. Retain existing life-safety systems, including but not limited to fire suppression systems, in place for as long as possible prior to performing associated demolition and removals.
 2. Where demolishing buildings or structures equipped with life-safety systems, remove or deactivate life-safety systems only in the area where active demolition operations are in progress.
- C. Demolition and Removals of Piping, Ductwork, and Similar Items:
1. Scope:
 - a. Safety purge piping and tanks (as applicable) of chemicals, fuel, solids, liquids, and gases (as applicable) and make safe for removal and capping. Discharge contents of existing piping appropriately while avoiding damaging property; restricting access to or use of property; and cresting unsafe, unsanitary, nuisances, and noisome conditions.
 - b. To the extent shown or indicated, remove existing piping conveying water (potable and non-potable), waste and vent, fuel (liquids and gases), heating fluids (such as water-glycol solutions), chemicals, solids and slurries, sludge, wastewater, other fluids, and processes gases, and other piping.

- c. Remove piping to the nearest structurally sound (or “solid”) piping support, and provide caps on ends of remaining piping.
 - d. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
2. Caps, Closures, Blind Flanges, and Plugs – General (All Piping and Ducts):
- a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
 - b. Where used in this Specifications section, the term “cap” means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
 - c. Caps shall be compatible with the piping or ductwork on which the cap is installed, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
 - d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Specifications section only when expressly so shown or indicated in the Contractor Documents or when allowed by Engineer.
3. Underground Facilities:
- a. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
4. Waste and Vent Piping; Ductwork:
- a. Remove waste and vent piping, and ductwork to extent shown and cap as required.
 - b. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials as existing, and fully compatible with ensign materials. Completed patch shall be watertight and comply with roofing manufacturer’s recommendations.
5. Potable Water Piping; Plumbing; Fire Suppression Piping and Systems; Heating Piping:
- a. Modifications to potable water piping, fire suppression systems, other plumbing piping, and heating system piping shall comply with Laws and Regulations.
 - b. All portions of potable water systems that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing and fire suppression piping and heating piping systems.
- D. Equipment Demolition and Removals:
1. To the extent shown or indicated and as required for the Work, remove existing mechanical equipment, including (but not limited to):
- a. Facility equipment, such as food service equipment, laundry equipment, dumbwaiters, and similar facility items.
 - b. Conveying equipment such as elevators, escalators, and similar general-use conveying systems.
 - c. Fire suppression and plumbing equipment.
 - d. Heating, ventilating, and air conditioning equipment.
 - e. Standby power generators.
 - f. Security systems equipment.
 - g. Transportation-related equipment.
 - h. Flow control gates and valves.
 - i. Hoisting equipment.
 - j. Bulk materials conveying equipment.
 - k. Process heating and cooling equipment.
 - l. Blowers, compressors, air filters, air dryers, and similar equipment.
 - m. Pumps.
 - n. Tanks.
 - o. Process equipment, including purification equipment, pollution control and solid waste equipment, and treatment process equipment.

- p. Turbines.
- q. Appurtenances (including motors, drive systems, controls, cooling water and seal water systems) as shown, indicated, and required for completion of the Work.
- 2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly and removal shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
- 3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
- 4. Tanks and Equipment Containing Process Material:
 - a. Purge contents in accordance with Paragraph 3.5.A of this Specifications Section and other requirements of the Contract Documents, as applicable.
 - b. When removing generators, remove associated fuel storage tanks unless otherwise indicated to remain.
 - c. Where contents of tank or equipment item may pose a potential hazard, such as hydrocarbon fuels or chemicals, properly dispose of contents in accordance with Laws and Regulations and the Contract Documents.
 - d. Where tank or equipment contains wastewater or liquid sludge, and the Site is a wastewater treatment facility, transport and dispose of stored contents onsite at location acceptable to Owner and facility manager (if other than Owner) unless otherwise indicated in the Contract Documents. If Site is other than a wastewater treatment facility, dispose of contents appropriately in accordance with Laws and Regulations.
 - e. Where tank or equipment contains solid or slurry-type material, remove, handle, and transport the contents and appropriately dispose of the materials offsite in accordance with Laws and Regulations, unless otherwise indicated in the Contract Documents.
- 5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the “Structural Removals” Article in this Specifications section.
- 6. Remove small-diameter piping back to header unless otherwise indicated.
- 7. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.
- 8. Instrumentation and Control Systems Removal:
 - a. Remove instrumentation and controls equipment in accordance with this Specifications section’s requirements for mechanical removals and electrical removals.

3.5 ELECTRICAL REMOVALS

- A. Electrical demolition Work includes removing existing:
 - 1. Disconnecting cabling from motors, electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
 - 2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
 - 3. Switches, panelboards, control stations, and similar items.
 - 4. Transformers, distribution switchboards, control panels, motors, starters, variable speed controllers, and similar items.
 - 5. Lighting fixtures and related items.
 - 6. Utility poles, site lighting standards, and overhead cabling.
 - 7. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.
- B. Electrical Removals – General:
 - 1. Comply with Laws and Regulations, including the National Electric Code.
 - 2. Lock Out and Tagging:
 - a. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.

- b. Upon completion of electrical removals Work, remove the locks and tags and promptly advise Resident Project Representative (RPR) or Engineer and Owner that existing facilities are available for use.
 - 3. Remove existing electrical equipment, fixtures, and systems to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.
 - 4. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated.
 - 5. Store removed motors, microprocessors and electronics, and other electrical gear to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.
- C. Motor Control Centers and Switchgear:
 - 1. Remove or modify motor control centers and switchgear as shown or indicated.
 - 2. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.
- D. Removal of Cabling, Conduits, Raceways and Similar Items:
 - 1. Verify the function of each cable before disconnecting and removing.
 - 2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
 - 3. Remove cabling, conduits, and similar items where shown or indicated for removal. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Engineer.
 - 4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
 - 5. Repair all areas of the Work to prevent rusting on exposed surfaces.
 - 6. Underground Electric:
 - a. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.
 - b. Where shown or indicated, remove direct-burial cabling. Openings in buildings for entrance of direct-burial cabling shall be patched with repair mortar or other material approved by Engineer for such purpose, and made watertight.
- E. Electrical Service Entrances and Outdoor, Overhead Electrical Utilities:
 - 1. Existing poles and overhead cabling shall be removed or abandoned as shown and specified.
 - 2. Completely remove from the Site poles not owned by electric utility, including site lighting standards and appurtenances, shown or indicated for removal.
 - 3. Existing substation(s) and poles owned by electric utility will be removed by the electric utility.
 - 4. Make necessary arrangements with electric utility owner for removal of utility owner's transformers and metering equipment after new electrical system has been installed and energized.
- F. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-Site as required in accordance with Laws and Regulations.

3.6 DEMOLITION OF SITE IMPROVEMENTS

- A. Pavement, Sidewalks, Curbs, and Gutters:
 - 1. Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
 - 2. To cut pavement, sidewalks, curbs, and gutters, use machinery or tools that provides a smooth-cut edge, appropriate for the required. Where cut edges are not smooth, repair the cut edge to remain to provide a smooth, even appearance.

- B. Manholes, Vaults, Chambers, and Handholes:
 - 1. Remove to the limits shown or indicated on the Drawings.
 - 2. If not shown or indicated on the Drawings, remove to not less than three feet below finished grade indicated on the Drawings.
- C. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes:
 - 1. Remove to the extent shown or indicated on the Drawings.
 - 2. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the “Mechanical Removals” Article in this Specifications section.
- D. Other Site Improvements: When the Contract Documents require removal of other site improvements not addressed above, copy with Contract requirements for removal of buildings or structures.

3.7 DISPOSAL OF DEMOLITION DEBRIS

- A. Disposal – General:
 - 1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal operations. Promptly upon completion of demolition and removal operations, remove from the Site construction equipment used in demolition Work.
 - 2. Do not sell at the Site demolition materials or removed equipment. If materials, equipment or debris will be sold by Contractor, remove the items from the Site and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.
 - 3. Cleaning and Removal of Debris: Comply with the General Conditions, Supplementary Conditions, and Section 01 74 00 - Cleaning.
- B. Transportation and Disposal:
 - 1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
 - 2. Hazardous Materials, Equipment, and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.
 - 3. Grit and Solids removed from Aeration Basins: Properly transport and dispose of grit and solids removed from Aeration Basins in Owner’s drying beds at Ohio Gulch Transfer Station. Ensure no free liquid drains onto roadway during transportation.
- C. Submit to Engineer information required in this Specification Section on proposed facility(ies) where demolition materials, equipment, and debris will be recycled. Upon request, Engineer or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Engineer and Owner.

END OF SECTION



DIVISION 03

CONCRETE



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SECTION 03 01 30
REPAIR AND REHABILITATION OF EXISTING CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Preparation and assessment of existing concrete for repair and rehabilitation:
 - a. Concrete removal for repairs.
 - b. Preparation of exposed reinforcing steel.
 - c. Preparation for joint sealant installation.
 2. Repair of damaged (and deteriorated) concrete.
 - a. Application of repair mortar.
 - b. Repair of exposed items embedded in concrete.
 3. Expansion joint repair.
- B. Scope:
1. Contractor shall provide all materials, equipment, labor, tools, services, and incidentals necessary to repair and rehabilitate existing concrete, whether damaged or deteriorated, at locations shown on the Drawings or at locations indicated by Engineer, in accordance with the Contract Documents.
 2. Re-sealing concrete joints as shown on the Drawings, and at other locations directed by Engineer, and indicated in this Section.
 - a. Included in the unit price(s) for joint sealant Work are repairs of existing concrete adjacent to the associated joint sealant Work, in accordance with this Section.
 3. Repair of concrete to protected against biogenic sulfuric corrosion is addressed in Section 03 01 03 - Concrete Biogenic Protection. Locations of concrete to receive protection against biogenic sulfuric corrosion are shown on the Drawings, indicated in Section 03 01 03 - Concrete Biogenic Protection, and at locations directed by Engineer.
 4. Repair of cracks in concrete existing prior to the Contract is addressed in Section 03 64 23 - Crack Repair and Injection.
- C. Related Requirements: Include but are not necessarily limited to:
1. Section 03 15 19 - Anchorage to Concrete.
 2. Section 03 21 00 - Reinforcement.
 3. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
 4. Section 07 92 00 - Joint Sealants.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices:
1. The Work of this Section is United Price Work unless otherwise shown or indicated. Work covered by this Section but not eligible for payment under Unit Price Work bid/pay items shall be performed at Contractor's expense.
 2. Bid/pay item classifications of Unit Price Work addressed in this Section are indicated in the Bid Form, the Agreement (or an exhibit thereto), and Section 01 22 00 - Measurement and Payment.
 3. Unit Price Work of this Section is classified as follows:
 - a. Concrete Surface Repair - Type I (Thin): Repair of spalled, delaminated, or deteriorated concrete up to 1.5 inches deep below concrete's original surface.
 - b. Concrete Surface Repair - Type II (Moderate): Repair of spalled, delaminated, or deteriorated concrete greater than 1.5 inches deep to 3 inches below original concrete surface.
 - c. Concrete Surface Repair - Type III (Severe): Repair of spalled, delaminated, or deteriorated concrete greater than 3 inches below original concrete surface.

- d. Expansion Joint Repair - Type A: Replacement of existing expansion joint material including removing existing backer rod, joint filler, and sealant and providing new materials and repair, in accordance with this Section. Expansion joint repair not designated in the Contract Documents as other types is Type A unless directed otherwise by Engineer.
- e. Expansion Joint Repair - Type B: Provide where shown or indicated on the Drawings or where directed by Engineer. Includes sealing existing expansion joints by providing new epoxy resin adhesive sealant system over existing expansion joints.
- f. Expansion Joint Repair - Type C: Provide where shown or indicated on the Drawings or where directed by Engineer. Includes sealing existing expansion joints by providing new polyurethane joint sealing system over existing expansion joints.

B. Measurement:

- 1. Criteria for measurement for payment of this Section's Unit Price Work are in the General Conditions (as may be modified by the Supplementary Conditions), Section 01 22 00 - Measurement and Payment, and this Section.
- 2. Quantities of this Section's Unit Price Work:
 - a. Unit Price Work of this Section shall be measured for payment prior to commencement of the associated Work in each work area.
 - b. Work not measured in advance for payment will not be eligible for payment by Owner.
 - c. Engineer will observe the associated concrete repair and rehabilitation Work performed. Such Work shall be in accordance with the Contract Documents for to such Work to be eligible for payment by Owner, even when such Work was measured (for payment) in advance.
- 3. Repair of new concrete Work provided by Contractor is not eligible for payment under the Unit Price Work bid/pay items covered by this Section. Such repairs are included in the Work of the associated bid/pay item under which the subject new concrete Work was provided.

1.3 REFERENCES

A. Terminology:

- 1. This provision indicates terminology used in this Section and in other Contract Documents that coordinate with this Section. Such terminology may or may not be indicated using initial capital letters and, when used in relation to the Work of this Section, have the meanings indicated below.
- 2. "Existing concrete damage" means damage to existing concrete surfaces deeper than 1/8 inches, such as:
 - a. Concrete corrosion.
 - b. Corroded items embedded within concrete or through the concrete surface.
 - c. Spalls.
 - d. Cracking at depth and arrangement that, in Engineer's sole opinion, cannot be repaired in accordance with Section 03 64 23 - Crack Repair and Injection.
- 3. "Installer" means the entity installing or applying repair materials at the Site. The terms "installer" and "applicator" have the same meaning. Installer or applicator may be Contractor or Subcontractor.
- 4. "MPII" means, "manufacturer's printed installation instructions".
- 5. "Rehabilitation" means repairing and restoring concrete to structurally-sound, durable condition suitable for the structure's intended purpose as determined by Engineer, including repair of existing concrete damage in accordance with this Section and other applicable provisions of the Contract Documents.
- 6. "Water-bearing structure" means concrete structure with a surface that is normally, or may be, in contact with water or process fluids or slurries during typical operation of the completed Project, including, but not limited to: tanks, channels, wet wells, distribution chambers, dams, and the like. Also, where specifically indicated on the Drawings, "water-

bearing structures” includes basements and structures extending below the ordinary, wet-season groundwater surface.

7. Other terminology used in this Section is consistent with terminology of ACI CT.

B. Reference Standards:

1. American Concrete Institute (ACI):
 - a. CT, Concrete Terminology.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 308, Standard Practice for Curing Concrete.
2. ASTM International (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - c. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - d. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - e. D1682, Breaking Load and Elongation of Textile Fabric.
 - f. D1876, Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).
 - g. D4060, Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - h. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - i. D4259, Standard Practice for Abrading Concrete.
 - j. D4263, Indicating Moisture in Concrete by the Plastic Sheet Method.
 - k. D7234, Standard Test Method for Pull-off Adhesion Strength of Coatings on Concrete Using Portable Pull-off Adhesion Tests.
3. International Concrete Repair Institute (ICRI).
 - a. 310.1R, Guide for Surface Preparation.
 - b. 310.1R, Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Steel Corrosion.
4. Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 13/NACE No. 6, Surface Preparation of Concrete.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Installer of materials for rehabilitation of existing concrete shall possess not less than five years of relevant experience performing concrete rehabilitation of similar type, scope, and complexity to that required for this Project.
 - b. Certification or Approval by Materials Manufacturer:
 - 1) Installer (as either business entity or individual) of materials associated with rehabilitation of existing concrete shall be certified or expressly approved in writing, by manufacturer of materials to be provided.
 - 2) As an option, installer may be certified or approved, in writing, at the Site during initial Work of this Section, in accordance with this Section’s Paragraph 3.4.D.
 - c. Submit documentation of qualifications and experience in sufficient detail to demonstrate to Engineer’s satisfaction compliance with requirements of this Section’s qualifications requirements.
2. Structural Concrete Repairer:
 - a. This provision is in addition to qualifications requirements applicable to installers of the Work under this Section. This provision applies to business entities physically performing rehabilitation of structural concrete.
 - b. Structural concrete repairer shall have not less than five years’ current, relevant experience in repairing and rehabilitating concrete structures in facilities of generally similar environmental exposures as the Work of this Section for this Project

- c. Submit documentation of qualifications and experience in sufficient detail to demonstrate to Engineer's satisfaction compliance with requirements of this Section's qualifications requirements.
3. Joint Sealant System Installer:
- a. This provision is in addition to qualifications requirements applicable to all installers of the Work of this Section. This provision applies to entities performing concrete joint sealant system repair or rehabilitation Work.
 - b. Entity performing joint sealant system Work shall possess not less than 10 years' relevant experience in waterproofing concrete joints, crack and leak repair, and concrete coating application on projects of similar size, complexity, and environment as the concrete joint sealing Work on this Project.
 - c. Entity performing concrete joint sealant system Work shall have completed not less than five projects of size, type, and complexity similar to the Work under this Section within the most-recent period indicated in the paragraph immediately above, on structures that have been in service for not less than three years each. Projects shall have utilized the required type of joint sealant system materials indicated for the Work.
 - d. Entity performing concrete joint sealant system Work shall be certified or approved, in writing, by joint sealant system manufacturer (whose product is used in the Work) to furnish and install the required concrete joint sealant system materials.
 - e. Submit documentation of qualifications and experience in sufficient detail to demonstrate to Engineer's satisfaction compliance with requirements of this Section's qualifications requirements
- B. Mock-Ups:
- 1. Mock-ups are Samples that, when approved by Engineer, indicate minimum standard of quality for the associated Work. Standard of quality of mock-ups shall be not less than that required by the Contract Documents.
 - 2. If so approved by Engineer, mock-ups may become part of completed Work.
 - 3. Maintain, segregate, identify, and protect mock-ups during performance of the Work to allow Engineer to readily compare the Work with approved mock-up.
 - 4. When mock-up is not part of the completed Work, remove mock-ups when directed by Engineer. If mock-up is part of the completed Work, remove protection and indication of mock-up when so directed by Engineer.
 - 5. Provide mock-up for each type of concrete rehabilitation required by this Section for which the Contract has an associated bid/pay item, including finish.
 - 6. Size of each mock-up shall be acceptable to Engineer. Concrete surface repair mock-ups shall be not less than 2 feet by 2 feet each. Expansion joint repair mock-ups shall be not less than 3 feet long, each.
 - 7. Where mock-ups will be part of the completed Work, Contractor and Engineer will jointly select the location of each mock-up.
 - 8. Concrete surface repair mock-ups shall include:
 - a. Sample of patched tie or bughole.
 - b. Sample of all jointing specified.
 - c. Sample of mortar repair.
 - 9. Expansion joint repair mock-ups shall include:
 - a. Repaired expansion joint.
 - b. Expansion joint seal.
 - c. Rehabilitation of adjacent concrete surfaces.
 - 10. Also provide concrete surface repair mock-up of wall having polymer-modified cementitious coating.
 - a. Mock-up shall be stepped to show surface preparation, repairs and coating in all stages of application.
 - 11. Mock-up areas shall be readily identifiable during construction. Provide appropriate temporary signage indicating status as mock-up and protect the mock-up.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule (table) indicating, for each type of concrete rehabilitation Work required by this Section, the material type and product manufacturer proposed for each application.
 - 2. Product Data:
 - b. Manufacturer’s published, technical data for each manufactured material proposed for use in the Work of this Section.
 - c. Manufacturer’s written certification that proposed materials comply with associated reference standards cited in this Section.
 - 3. Samples:
 - a. Advise Engineer in writing when required mock-ups will be provided and the location proposed for each.
 - 4. Test Procedures:
 - e. Procedure for pre-repair condition survey required in this Section's Article 3.1, including method for recording results of survey.
 - f. Written method of performing pull-off testing of repair material and testing equipment information and accessory materials proposed for use in testing.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Laboratory test reports (for previously-tested materials identical to those to be furnished) and material manufacturer’s certificates verifying that ingredients comply with the Contract Documents and have a minimum of six months’ residual shelf life at the time of shipment to the Site.
 - b. Certification from Supplier stating that material is suitable for the intended use on this Project.
 - c. Certification that materials proposed for use are compatible with each other, when such materials will contact each other, and will not interfere with bonding of future floor or wall finishes.
 - 2. Test and Evaluation Reports:
 - a. Results of pre-rehabilitation condition survey required in this Section’s Article 3.1.
 - 3. Manufacturer’s Instructions:
 - a. Manufacturer’s instructions for all concrete rehabilitation materials, for handling, storing, and installing materials.
 - 4. Field Quality Control Submittals:
 - a. In-situ pull-off test results for joint sealant system.
 - 5. Qualifications Statements:
 - a. Installer: Documentation of qualifications in accordance with this Section’s “Quality Assurance” Article.
 - b. Manufacturer’s written approval of installer or certification of training performed at the Site in accordance with Paragraph 3.4.D of this Section.
 - 1) Affidavit, signed by either materials manufacturer or by installer’s business entity, indicating that manufacturer of rehabilitation materials has instructed installer in proper handling and installation of each rehabilitation material to be used in the Work.
 - c. Entity performing structural concrete repair Work.
 - d. Entity performing joint sealant system Work.
- C. Closeout Submittals: Submit the following:
 - 1. Affidavit of compliance from joint sealant system manufacturer, certifying that sealants were installed at the Site in accordance with manufacturer’s written instructions and recommendations.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with material manufacturer's written instructions and recommendations regarding delivery, handling, and storage of materials to be incorporated into the Work.
- B. Storage:
 - 1. Store materials in tightly-sealed, original containers, off the ground and in dry location with humidity controls.
 - 2. Do not store in direct sunlight.
 - 3. Protect materials from temperature extremes and avoid freezing temperatures.

PART 2 - PRODUCTS

- A. Subject to compliance with Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Anti-Corrosion Bonding Agent:
 - a. Sika Corporation.
 - b. Euclid Chemical Company.
 - c. Master Builders Solutions.
 - d. Or equal..
 - 2. Epoxy Bonding Adhesive:
 - a. Sika Corporation.
 - b. Euclid Chemical Company.
 - c. Or equal.
 - 3. Repair Mortar:
 - a. Master Builders Solutions.
 - b. Euclid Chemical Company.
 - c. Five Star Products, Inc.
 - d. Sika Corporation.
 - e. Or equal.

2.2 MATERIALS

- A. Materials that will be in direct contact with potable water or water that will be treated to become potable shall be certified in accordance with ANSI/NSF 61 and suitable for prolonged immersive exposure to chlorinated water with a total residual of up to 5 mg/l.
- B. Bonding Agents:
 - 1. Bonding agents and adhesives shall have pot life that allows proper placement of new material against existing material in accordance with manufacturer's written instructions.
 - 2. For repair of existing concrete damage, when no reinforcing steel is exposed, and where specifically shown or indicated on the Drawings, use epoxy bonding adhesive.
 - 3. For repair of existing concrete damage, when reinforcing steel is exposed, and where specifically shown or indicated on the Drawings, use anti-corrosion bonding agent.
 - 4. For repair of new concrete: Comply with Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
- C. Water:
 - 1. Potable.
 - 2. Clean and free from deleterious substances.
 - 3. Free of oils, acids and organic matter.
- D. Reinforcing Steel: In accordance with 03 21 00 - Reinforcement.
- E. Epoxy Patch Seal:
 - 1. For use as seal on patches at repair of existing concrete damage and as otherwise shown or specified in the Contract Documents.
 - a. Sikadur 32 Hi-Mod LPL by Sika Corporation.
 - b. Or equal.

- F. Anti-Corrosion Bonding Agent:
1. Three-component, moisture tolerant, cementitious bonding agent manufactured for purpose of bonding fresh concrete to hardened concrete and providing anti-corrosion coating to embedded reinforcing materials.
 - a. Sika Armatec 110 EpoCem by Sika Corporation.
 - b. Duralprep A.C. by Euclid Chemical Company.
 - c. Or equal.
- G. Epoxy Bonding Adhesive:
1. For use where bonding new concrete or patch material to existing concrete.
 2. Two-component, moisture insensitive adhesive manufactured for purpose of bonding fresh concrete to hardened concrete.
 - a. Sikadur 32 Hi-Mod LPL by Sika Corporation.
 - b. Euco No. 452 MV by Euclid Chemical Company.
 - c. Or equal.
- H. Repair Mortar:
1. Pre-packaged cement-based, modified (polymer or latex) product specifically formulated for repair of concrete surface defects, with the following properties:

Physical Property	Value	ASTM Standard
Compressive strength (minimum)		C109
at one day	2000 psi	
at 28 days	6000 psi	
Bond strength (minimum)		C882 (*)
at 28 days	1800 psi	

(*) Modified for use with repair mortars.

2. Trowelable, selection based on horizontal, vertical, or overhead application.
 3. Where the least dimension of the placement, in width or thickness, exceeds 1.5 inches, repair mortar shall be extended by addition of aggregate per MPII.
 4. Acceptable Products:
 - a. Five Star Structural Concrete by Five Star Products, Inc.
 - b. SikaRepair SHA, SikaTop 123 Plus, SikaTop 111 Plus by Sika Corporation.
 - c. Verticoat by Euclid Chemical Company.
 - d. Emaco S88-CI, Emaco S66-CI by BASF Corporation.
 - e. Or equal.
- I. Epoxy Coating:
1. Use as a coating over concrete repairs and at repaired embedded items in concrete where shown or indicated on the Drawings.
 2. Pigmented, two-component, 100% solids, moisture-tolerant epoxy resin specifically formulated to serve as a protective, corrosion-resistant coating to all common structural substrates.
 3. Acceptable Products:
 - a. Sikagard 62 by Sika Corporation.
 - b. Or equal.
- J. Epoxy Resin Adhesive Sealing System:
1. Provide sealing system consisting of the following components:
 - a. Epoxy Resin Adhesive:
 - 1) Two-component, 100% solids, high-strength, non-sag structural epoxy paste adhesive.
 - 2) Color: Gray.

- 3) Minimum Pot Life: 30 minutes.
 - 4) Acceptable Products:
 - a) Sikadur 31 Hi-Mod Gel .
 - b) Or equal.
 - b. Hypalon Sheeting:
 - 1) Composed of Hypalon rubber with perforations along bonding edges of sheeting to provide mechanical key.
 - a) Shall have the ability to be vulcanized with aromatic hydrocarbon solvent to allow its adhesion to an epoxy resin adhesive.
 - b) Sheet Dimensions: 8 inches wide and 40 mils thick.
 - c) Provided with a removable center expansion strip.
 - c. Activating Solvent:
 - 1) Aromatic hydrocarbon with a specific gravity of 0.86.
 - 2) All sealing system components shall be fully compatible with each other.
 - 3) Acceptable Products:
 - a) Sikadur Combiflex System by Sika Corporation.
 - b) Or equal.
- K. Polyurethane Joint Sealing System:
- 1. Provide high-solids, two-component liquid, cold-applied, asphalt extended urethane elastomer that cures to durable abrasion-resistant film, forming flexible, water-impermeable barrier.
 - 2. Provide all components from a single manufacturer to ensure compatibility of components with each other, except for hydrophobic polyurethane grout material.
 - 3. Concrete Surface Primer: Acceptable products:
 - a. CIM 61BG Epoxy Primer, by CIM Industries.
 - b. Or equal.
 - 4. Tack Coat and Top Coat: Acceptable products:
 - a. CIM 1061, by CIM Industries.
 - b. Or equal.
 - 5. Joint/Crack Filler: Acceptable products:
 - a. CIM 1000TG, by CIM Industries.
 - b. CIM 1000TG Cartridges, by CIM Industries.
 - c. Or equal.
 - 6. Cant Strip Material: Acceptable products:
 - a. CIM 1000 TG Cartridges, by CIM Industries
 - b. Or equal..
 - 7. Reinforcing Fabric (Scrim): Acceptable Products:
 - a. CIM Scrim, by CIM Industries.
 - b. Or equal.
 - 8. Bonding Agent (for re-application of CIM 1061 if recoat window exceeded):
 - a. Acceptable products:
 - 1) CIM Bonding Agent, by CIM Industries.
 - 2) Or equal.
 - b. Material:
 - 1) Organo-silane compound dispersed in isopropyl alcohol.
 - 9. Hydrophobic Polyurethane Grout: Acceptable products:
 - a. SikaFix HH LV, by Sika Corporation.
 - b. De Neef Hydro Active Flex LV, by GCP Applied Technologies.
 - c. Or equal.
- L. Expansion Joint Sealant and Backer Rod:
- 1. Provide in accordance with Section 07 92 00 - Joint Sealants.

PART 3 - EXECUTION

3.1 PREPARATION AND ASSESSMENT

- A. As indicated in Article 1.1 of this Section, repair of surface defects in new concrete provided under the Contract and repair of cracks in concrete are addressed in other Specification Sections.
- B. Condition Survey:
 - 1. Contractor and Engineer shall jointly perform condition survey of each existing concrete structure included in the scope of the concrete repair Work before scheduling and performing the associated repair Work.
 - 2. Contracting and payment for specialty inspections and tests by third-parties will be by Owner.
 - 3. Prior to Condition Survey:
 - a. Submit to Engineer, and obtain Engineer's acceptance, of procedure for performing condition survey. Indicate proposed date(s) of the condition survey and other procedures for inspecting and documenting extent of concrete repair Work to be performed.
 - b. Prior to the condition survey, power-wash all concrete surfaces within the scope of the concrete repair Work. Power-wash at not less than 4,000 psi using orbital nozzle.
 - 4. Condition survey shall include, but is not necessarily limited to:
 - a. Visual inspection for:
 - 1) Deficiencies in joints.
 - 2) Cracks.
 - 3) Leakage and efflorescence.
 - 4) Scaling.
 - 5) Spalling
 - 6) Exposed reinforcing.
 - 7) Previous repairs.
 - b. Extent of chemical attack using phenolphthalein.
 - c. Delamination survey.
 - d. Half-cell measurements for corrosion potential of reinforcing.
 - 5. Results of Condition Survey:
 - a. Submit written results of condition survey to Engineer promptly following the condition survey at the Site.
 - b. Condition survey results shall clearly indicate the location, nature, size, length, width, and depth of all deficiencies in existing concrete in the area(s) surveyed.
 - c. Engineer will use results of condition survey to determine extent of repair Work required.
 - 6. Engineer's Direction to Contractor:
 - a. After consulting with Owner as necessary, Engineer will transmit to Contractor written direction on extent of concrete repairs required.
 - b. Engineer will issue such direction promptly after Engineer's receipt of acceptable results of condition survey. Allow in the Progress Schedule 14 days for issuance of Engineer's written direction.
 - c. Where such Work would either exceed Contract quantities of associated Unit Price Work or requires Work not in the Contract's bid/pay items, an appropriate Contract modification will be issued.
- C. Concrete Removal:
 - 1. Remove all loose and unsound concrete from areas to be repaired, in accordance with ICRI Guideline 310.1R, as modified by the Contract Documents.
 - 2. Removals:
 - a. At areas of damage or deterioration of existing concrete, saw-cut the perimeter of unsound concrete surface areas, to depth of not less than 1/2 inches.

- b. Saw-cuts to be perpendicular to or slightly undercutting existing concrete surface. Concrete removal boundaries shall be straight and aligned parallel to opposite boundary edges resulting in repair areas that are approximately rectangular.
 - c. Remove all existing concrete from within the saw-cut repair boundary to of not less than 1/2 inches.
 - d. Feathered edges are unacceptable.
3. Clean surfaces of repair areas in accordance with ASTM D4258 to remove dust, dirt, grease, and other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
 4. Abrasive-blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
 5. Chip concrete substrate to obtain a surface profile of 1/16 inches to 1/8 inches deep with new fractured aggregate surface. The area to be repaired shall not be less than 1/2 inches in depth.
 6. Concrete removal shall extend along any exposed existing reinforcing to locations along the bar that are free of bond inhibiting corrosion and where the bar is well-bonded to surrounding concrete.
 7. Rinse surface with clean water and allow surface water to evaporate prior to repairing the surface.
- D. Preparing Exposed Steel Reinforcing:
1. Clean and prepare exposed embedded steel reinforcing in accordance with ICRI Guideline 310.1R and the Contract Documents.
 2. Where one-half or more of the steel reinforcing diameter is exposed, either by existing conditions or concrete removal, bond between concrete and steel reinforcing is inhibited or lost completely, or corrosion is present, remove concrete to provide not less than 1 inch clearance around the entire perimeter and along the entire exposed length of the steel reinforcing.
 3. If existing, exposed steel reinforcing is cut through, cracked, or cross-sectional area is reduced by more than 20%, provide new steel reinforcing bar the same size as existing steel reinforcing. Lap the new bar with existing in accordance with ACI requirements. Coat all new and existing steel reinforcing with anti-corrosion bonding agent, as specified in this Section. Abrasive-blast exposed reinforcing to remove contaminants and corrosion to provide white-metal, bright steel finish.
- E. Preparation for Joint Sealant System Installation:
1. Provide adequate surface preparation in area of each joint sealant repair, to not less than 6 IN from face of joint, on each side of joint.
 2. Surface preparation shall remove existing concrete laitance, loose material, oil, grease, and shall expose tops of underlying aggregate to an ICRI concrete surface profile of 4-6. The following methods may be used:
 - a. Abrasive-blasting in accordance with ASTM D4259.
 - b. High-pressure water blasting at not less than 5,000 psi, in accordance with ASTM D4259.
 - c. Shot-blasting in accordance with ASTM D4259, at horizontal surfaces only.
 3. Concrete joint areas to receive joint sealant system shall be fully dried prior to application of joint sealant system. Test substrate moisture at not less than three locations per structure to confirm moisture. The following methods may be used to determine moisture:
 - a. Plastic Sheet Method (ASTM D4263): Pass/fail.
 - b. Relative Humidity Test (ASTM F2170): Less than 85%.
 - c. Calcium Chloride Test: Less than 5 pounds per 1000 square feet per 24 hours.
 - d. Radio Frequency Test: Less than 5% moisture.
 4. Perform adhesion tests at not less than three locations per structure in mock-up (non-joint) areas to verify adequacy of the joint surface preparation. Perform modified T-Peel (ASTM D1876) field test:
 - a. Apply duct tape on substrate.
 - b. Apply the coating top coat material to the substrate, fully lapping onto the duct tape.

- c. After coating material has fully cured, cut 1 inch wide strips through coating material, perpendicular to duct tape strip: a minimum of three pull tests per testing location.
 - d. Peel up the outside edge of duct tape and provide tarp clip.
 - e. Hook a fish weighing or similar scale through the tarp clip and pull perpendicular to the substrate to point of coating adhesion failure and record the load at failure. Scale used for this field measurement shall be calibrated immediately prior to testing.
 - f. Minimum acceptable coating adhesion force at failure shall be 15 pounds; no test performed shall demonstrate adhesion below this threshold for surface preparation to be acceptable.
5. Inspect concrete surfaces in area of surface preparation and repair as follows:
 - a. Blast/expose all bug-holes to eliminate blind side surfaces.
 - b. Cracks less than 1/16 inches wide that extend through the joint coating areas do not require special treatment.
 - c. Cracks 1/16 inches to 1/8 inches wide that extend through the joint coating areas shall be stripe-coated for not less than 2 inches on each side and filled with CIM (trowel grade) prior to application of the joint sealant system (after moisture content and surface preparation are acceptable in accordance with the Contract Documents)
 - d. Cracks greater than 1/8 inches wide and cracks that experience movement (that extend through the joint coating areas) shall be reinforced with scrim material, similar to the joint coating, prior to sealing the joints.
 - e. Cracks greater than 1/4 inches -wide: Provide backer rod, in addition to complying with the paragraph immediately above.
 - f. In areas of joint coatings, patch surface spalls and other concrete defects in accordance with requirements for concrete repairs indicated in this Section.
 6. Inspect existing joint filler material. If defects in existing joint filler material extend greater than 1/2 inches deep, or if determined by sealant installer to be unsatisfactory, remove not less than 1 inch of existing filler material and pack joint with appropriately sized backer rod soaked in polyurethane grout. Trim grout foam/backer rod flush with surface of concrete once cured. Joints to be coated shall be filled according to this provision and trimmed flush prior to application of coating system.
 7. Provide and tool 1 inch minimum cant strips at wall-slab and slab-column joints to be coated. Allow cant strips to cure prior to applying coating system.
 8. Perform surface preparation, substrate moisture field tests, adhesion test results, treatment of defects in joint coating areas, and filling (as required) of existing joints for approved by coating manufacturer's technical representative prior to installing joint coating system.

3.2 INSTALLATION AND APPLICATION

- A. Environmental Conditions for Installation:
 1. Comply with material manufacturer's written instructions for substrate temperature and moisture content, ambient temperature, and ambient humidity, ventilation, and other conditions affecting performance of concrete repair materials.
 2. Do not repair existing concrete damage when ambient temperature is or is expected to be below 50 degrees F. If necessary to maintain the progress Schedule, enclose and heat area to between 50 and 70 degrees F during repair of surface defects and curing of patching material. Use only indirect fired heating using clean-burning fuel.
 3. If proper environmental conditions do not comply with the Contract Documents and manufacturer's instructions, do not perform the Work until such conditions are acceptable. Provide means to bring conditions into compliance by providing temporary environmental controls, enclosures, and other temporary construction and temporary facilities.
 4. Contractor is not eligible for changes in Contract Times or Contract Price for delays or costs incurred to bring environmental conditions for installation into compliance.
- B. Existing Concrete Damage Repair:
 1. Type I Repair:
 - a. Provide epoxy bonding adhesive and repair mortar.

2. Type II Repair:
 - a. Provide epoxy bonding adhesive, if no reinforcing steel is exposed. Use anti-corrosion bonding agent, if reinforcing steel is exposed.
 - b. Prepare exposed reinforcing steel in accordance with Paragraph 3.1.D of this Section.
 - c. Provide repair mortar:
 - 1) Provide 3/8 inches aggregate in accordance with MPII.
 3. Type III Repair:
 - a. Provide anti-corrosion bonding agent.
 - b. Prepare exposed steel reinforcement per the requirements of Paragraph 3.1.B.
 - c. Provide new adhesive anchor dowels as shown on the Drawings and as indicated in Section 03 15 19 - Anchorage to Concrete.
 - d. Provide repair mortar:
 - 1) Provide 3/8 inches aggregate in accordance with MPII.
- C. Repair Mortar Application:
1. Comply with MPII for mixing and placement of repair mortar.
 2. After initial mixing of repair mortar, do not introduce additional water to change consistency. Discard repair mortar if consistency becomes too stiff to place.
 3. Place repair mortar to not less than recommended minimum thickness indicated in the MPII and in no event less than 3/8 inches.
 - a. Apply repair mortar in accordance with the following minimum requirements:
 - 1) Not less than 3/8 inches over existing sound, exposed coarse aggregate.
 - 2) Not less than 2 inches of cover (unless otherwise required) over exposed reinforcing steel.
 4. At horizontal applications, repair mortar shall be screeded and bullfloated to the proper elevation, to ensure all surface moisture will drain freely and properly without puddle areas.
 5. Provide repair mortar in even, uniform plane to restore the concrete member to its original surface finish and plane.
 - a. Tolerance for being out-of-plane shall be such that gap between a 1 foot straight edge and repair mortar surface shall not exceed 1/4 inches, and gap between a 4 feet straight edge and repair mortar surface shall not exceed 3/8 inches. This shall apply to straight edges placed in any orientation at any and all location on the repair mortar surface.
 6. Prevention of Drying:
 - a. Prevent exposed plastic mortar surfaces from drying. Provide windbreaks, foggers, and evaporation retarders, as necessary, during finishing.
 - b. Foggers shall maintain humidity at height of 2 feet to 3 feet above surface of concrete.
 - c. If necessary, apply evaporation retarder between finishing operations.
 7. Repair mortar shall receive smooth, steel troweled finish.
- D. Repair of Exposed Embedded Items in Concrete:
1. This provision addresses repair and rehabilitation of corroded metal items embedded in existing concrete and to other locations as expressly shown or indicated on the Drawings. Existing concrete damage by corrosion of embedded metal shall be repaired in accordance with this Section's Paragraph 3.2.B.
 2. Preparation:
 - a. Fully expose extent of metal corrosion within each embedded item by chipping to sound material. Where specifically shown or indicated on the Drawings, completely remove exposed metal item to extent shown or indicated.
 - b. Prepare exposed reinforcing steel attached to or adjacent to embedded, corroded metal items in accordance with this Section's Paragraph 3.1.D.
 - c. If existing concrete has been removed during chipping and repair of metal item, prepare repair area in accordance with this Section's Paragraph 3.1.C.
 - d. Remove corrosion on embedded metal item and corrosion on exposed reinforcing steel by abrasive blasting to a white-metal finish.
 3. Repair:

- a. Where no existing concrete has been removed or damaged adjacent to embedded metal item:
 - 1) On surface of embedded metal item, provide two coats of epoxy coating in accordance with coating manufacturer's recommendations.
 - a) Color of First Coating: Red.
 - b) Color of Second Coating: Gray.
 - 2) Before applying second coat, allow first coat of epoxy coating to fully cure in accordance with coating manufacturer's recommendations.
 - b. Where areas of existing concrete have been removed or damaged adjacent to embedded metal item:
 - 1) Patch area of removed or damaged concrete in accordance with this Section's Paragraph 3.2.B.
 - 2) Provide on surface of embedded metal item two coats of epoxy coating in accordance with coating manufacturer's recommendations.
 - a) Color of First Coat: Red.
 - b) Color of second Coat: Gray.
 - 3) Before applying second coating, allow first coat of epoxy coating to fully cure in accordance with coating manufacturer's recommendations.
- E. Extend existing control, construction, and expansion joints through concrete repairs.
- F. For repairs of existing concrete damage, finish of repaired areas shall match the finish of existing adjacent concrete surface.
- G. Expansion Joint Repair – Type A:
1. Provide materials and installation methods in accordance with sealant manufacturer recommendations and the Contract Documents.
 2. Provide sealant and backer rod at moderate, reasonably stable, concrete temperature to optimize repair performance.
 3. Comply with Section 07 92 00 - Joint Sealants.
- H. Expansion Joint Repair – Type B:
1. Provide epoxy resin adhesive sealing system, in accordance with joint sealant system manufacturer's instructions and the Contract Documents, at locations shown or indicated on the Drawings:
 - a. Existing sealant, backer rod, and joint filler material in acceptable condition are to remain in-place at existing joint locations to receive sealing system.
 - b. Concrete substrate on both sides of existing joint must be clean, dry, sound, and free of surface contaminants to not less than 10 inches wide strip centered on existing joint or greater when recommended by sealant manufacturer.
 - 1) Remove dust, laitance, grease, oils, curing compounds, form release agents, and foreign matter by sandblasting or other mechanical means acceptable to Engineer.
 - c. Mix epoxy resin adhesive and install hypalon sheeting in accordance with adhesive manufacturer's printed installation instructions and the Contract Documents.
 - d. Cleanup:
 - 1) Leave finished Work and work area in a neat, clean condition without evidence of spillovers on adjacent surfaces.
 - 2) Clean uncured epoxy resin adhesive with approved solvent appropriate for the application and area.
 - 3) Remove cured epoxy resin adhesive only by mechanical means.
- I. Expansion Joint Repair – Type C (Joint Sealant System):
1. Installation of joint coating system shall comply with applicable material manufacturer's published recommendations and the Contract Documents.
 2. Do not install concrete joint coating when substrate is in a rising-temperature mode.
 3. Substrate, air, and coating material temperatures shall comply with applicable material manufacturer's recommendations and the Contract Documents.

4. Primer:
 - a. Provide epoxy primer to concrete prior to installing final coating materials.
 - b. Applied Thickness: 5 to 10 wet mils.
 - c. Reapply coating as necessary to achieve pinhole/holiday-free surface
5. Comply with material manufacturer's recoat time. If recoat time(s) are exceeded, comply with material manufacturer's recommended procedures for surface abrasion, cleaning, and application of bonding agent.
6. Application of Coatings:
 - a. Provide primer, base coat, scrim, and top coat in accordance with material manufacturer's requirements, as shown in the Drawings, and in accordance with other Contract Documents.
 - b. Install primer (see item 4 above)
 - c. Provide initial tack coat at thickness of 10 to 20 wet mils, to 6 inches on each side of joints to be coated.
 - d. Push scrim material evenly into wet tack coat and allow to cure one to four hours, as recommended by coating manufacturer.
 - e. Provide not less than thickness of 60 wet mils of top coat over scrim material.
 - f. Protect and cure in accordance with material manufacturer's recommendations and the Contract Documents.
7. Should substrate temperatures be less than sealant system manufacturer's written recommended minimum temperature, comply with material manufacturer's modified procedures provide materials approved by Engineer and suitable for installation in cold conditions.

3.3 CURING

- A. Curing of Repair Mortar:
 1. Perform curing of repair mortar immediately after final finishing.
 2. Perform curing by combination of covering repair Work with wet burlap and applying liquid membrane-forming curing compound.
 3. Employ methods and sequence to maintain moisture for not less than seven days.

3.4 FIELD QUALITY CONTROL

- A. Field Tests:
 1. In-Situ Pull-Off Tests:
 - a. Perform in-situ pull-off tests on repaired areas at locations indicated by Engineer.
 - 1) Perform not less than one pull-off test, in accordance with ASTM C1583, for each surface (wall, roof, floor, and other). In event of unacceptable pull-off test, repair the defective Work in accordance with the Contract Documents and perform additional test(s) at location(s) indicated by Engineer.
 - b. Submit written results of testing, indicating: date of test, entity performing testing, personnel present during testing, time of test, location of test, pertinent results recorded, and other relevant observations.
 - c. Criteria for Acceptance: Pull-off test will be deemed as passing (acceptable results) when failure occurs within the existing concrete substrate (cohesive concrete failure). If failure occurs at the joint surface with existing concrete (bond failure), within the repair material, or at connection to testing device, pull-out test will be deemed as passing (acceptable results) when the unit tensile stress acting on the core cross section at failure exceeds 300 psi. If failure occurs within the repair material, additional test samples of the repair material in the area of the test shall be taken for compressive testing to verify strength of repair material.
 - d. Remedy all damage resulting from in-situ testing, in accordance with the Contract Documents.
- B. Observations and Inspections:

1. Engineer will witness surface preparation, substrate moisture conditions, and installation of materials indicated in this Section. Such observations do not relieve Contractor from obligation to comply with the Contract Documents.
 2. Owner-retained special inspector shall be present while material manufacturer's technical representatives are at the Site instructing Contractor's structural concrete repair personnel, Contractor's joint sealant system personnel, and installers in the use of the associated material(s).
- C. Defective Work:
1. Defective Repair:
 - a. Any and all repairs are defective Work when one or more of the following occurs:
 - 1) Pull-off test fails.
 - 2) When grout cube tests yield results less than 3500 psi for repair mortars in seven days.
 - 3) Repair is not properly finished and in accordance with specified tolerances.
 - b. Promptly remove and remedy defective concrete repair Work in accordance with the Contract Documents.
 2. Damaged Work:
 - a. Before acceptance of the Work (following final inspection in accordance with the General Conditions and other Contract Documents), neatly repair damaged surfaces, corners of concrete, and finish.
 - b. When performing surface remedial repairs, finish areas to smooth, dense watertight condition.
 - c. Replace unsatisfactory concrete patching Work.
 3. Corrective Work:
 - a. If correction of defective Work (under this Section) is necessary, remove defective Work. Key area to be remedied, clean, and soak surface with water and patch with approved materials. Patch concrete to match existing adjacent concrete surfaces.
 - b. Clean surface cavities resulting from form ties, other holes, honeycomb spots, broken corners and edges, and other effects. Saturate with water and point with a mortar of patching material paste. Comply with patching material manufacturer's recommendations concerning placement, pot life, and curing.
 - c. Prepare pointing material not more than 30 minutes prior to use. Cure mortar patches properly. Carefully tool contraction and articulated joints in completed Work and keep them free of concrete. Where necessary, leave joint filler exposed for its full length with clean and true edges.
 - d. Tolerance deviations and other surface defects may also be corrected, when approved by Engineer, by grinding high areas of swales.
 - e. Where remedial work is unsatisfactory, completely remove such Work and replace with new Work in accordance with the Contract Documents.
 4. Special inspection of remedial work is required. Special inspection will be performed after completion of surface preparation and during installation of remedial Work. Refer to Section 01 45 33 - Code Required Special Inspections and Procedures, for additional requirements.
 5. Defective Joint Sealant System Work:
 - a. Any and all locations where joint sealant system has separated from concrete or exhibits cracking or tearing is defective Work.
 - b. Remove defective joint sealant system Work, clean the surface, and re-provide new joint sealant system materials.
 - c. Unless directed otherwise by Engineer, when area of defective joint sealant Work exceeds 25% of total area of joint sealant system Work provided, replace all joint sealant system Work in accordance with the Contract Documents.
- D. Suppliers' Services:
1. Manufacturers' factory-trained technical representatives of concrete repair materials and joint sealant system shall be at the Site prior to and during first installation of the materials

furnished under this Section to review surface preparation, surface moisture conditions and adhesion testing, and proposed installation methods. Joint sealant system manufacturer's representative shall also inspect the entire completed installation and submit, through Contractor, an affidavit of compliance certifying that installed materials comply with manufacturer written instructions and recommendations. Compensation for which is part of the associated unit price for such Work.

3.5 POST-CONSTRUCTION OBLIGATIONS

- A. Warranty Inspection:
1. Perform warranty inspections during eleventh month after Substantial Completion of the Work of this Section.
 2. For the inspections, Owner will dewater and reasonably clean water-bearing structures.
 3. Operational constraints preclude removing all water-bearing structures from service simultaneously for warranty inspection. It is anticipated that oneseperate warranty inspections will be necessary due to operational constraints, each on different, non-consecutive days.
 4. One warranty inspection of each joint sealed is required, unless defective Work is evident. When defective joint sealant Work is apparent, an additional warranty inspection of the repaired joint is required in the eleventh month after the defective joint sealant is remedied.
 5. Contractor, joint sealant Subcontractor (if any), joint sealant system manufacturer's technical representative, Engineer, and Owner, shall be present at each warranty inspection.
 6. Contractor shall promptly remedy and replace defective Work, whether evident during the warranty inspection or otherwise, in accordance with the Contract Documents.
 7. If contractor is unable or unavailable to remedy defective Work promptly when water-bearing structures are dewatered and cleaned for the warranty inspection, Owner may place such structures back into service and Contractor will be responsible for appropriately dewatering and cleaning the structure to perform the necessary remedial Work.
 8. Regarding remedy of defective joint sealant system Work, refer to this Section's Paragraph 3.4.C.
- B. Item 1 – Concrete Surface Repair - Type I (Thin):
1. Measurement will be the area, in square feet, of existing, concrete surface area repaired, measured in one or more appropriate geometric shapes such as rectangles, squares, triangles, and trapezoids, at the concrete surface.
 2. Item Includes (all in accordance with the Contract Documents):
 - a. As indicated in Section 03 01 30 - Repair and Rehabilitation of Existing Concrete.
 3. Not included in this bid/pay item:
 - a. As indicated in Section 03 01 30 - Repair and Rehabilitation of Existing Concrete.
 4. Payment: Unit price per square foot for this item will be full compensation for Work for surface repair of the type indicated for existing concrete, and all related Work, performed under this item, complete in accordance with the Contract Documents, and not specifically included under other bid/pay items or contracts.
- C. Item 2 – Expansion Joint Repair - Type A:
1. Measurement will be the length, in linear feet, of existing, concrete expansion joint repaired, measured at the concrete surface.
 2. Item Includes (all in accordance with the Contract Documents):
 - a. As indicated in Section 03 01 30 - Repair and Rehabilitation of Existing Concrete.
 3. Not included in this bid/pay item:
 - a. As indicated in Section 03 01 30 - Repair and Rehabilitation of Existing Concrete.
 4. Payment: Unit price per linear foot for this item will be full compensation for all expansion joint repair Work of the type indicated, and all related Work, performed under this item, complete in accordance with the Contract Documents, and not specifically included under other bid/pay items or contracts.

END OF SECTION

SECTION 03 05 05
CONCRETE TESTING AND INSPECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Contractor requirements for testing of concrete and grout.
 2. Definition of Owner provided special inspections.
 3. Acceptance criteria for concrete.
 4. Materials and concrete testing as required to establish concrete mix design.
 5. Testing of concrete during construction for compliance with Contract Documents.
 6. In-place testing of concrete, if required.
 7. Mortar, grout for masonry, and concrete masonry unit testing as required by Specification Section 04 05 13 and Specification Section 04 22 00.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 03 21 00 - Reinforcement.
 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.
 6. Section 03 41 33 - Precast and Prestressed Concrete.
 7. Section 04 05 13 - Cement and Lime Mortars.
 8. Section 04 22 00 - Concrete Masonry.

1.2 RESPONSIBILITY AND PAYMENT

- A. Contractor shall hire a qualified independent testing agency to perform the following testing and provide test results to the Engineer and Owner. The hiring shall be done jointly after contract award with input from Owner and Engineer. The protocol for complete independence of Testing Agency from Contractor shall be developed by the Owner/Engineer. Monthly testing cost invoices shall be sent to Owner/Engineer/Contractor and applied to the allowance amount in the schedule of values.
1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
 2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor. Retesting costs by failure shall be paid by Contractor and not be part of the Testing allowance.
 3. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents. Retesting costs by failure shall be paid by Contractor and not be part of the Testing allowance.
 4. Additional testing or retesting of materials occasioned by their failure, be test or inspection, to meet requirements of the Contract Documents. Retesting costs by failure shall be paid by Contractor and not be part of the Testing allowance.
 5. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient. Retesting costs by failure shall be paid by Contractor and not be part of the Testing allowance.
 6. Other testing services needed or required by Contractor such as field curing of test specimens, testing of additional specimens for determining when forms, form shoring or reshoring may re-removed and additional geotechnical services.

7. Pay for services defined in this Paragraph by using a cash allowance included in the bid price. The allowance amount for the Testing Agency is \$50,000 per General Conditions Section 13.02.
 8. Pay directly or reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.
 9. Sampling and testing specified in Paragraphs 1.2A.3. through 1.2A.6. inclusive, shall be witnessed by Owner's Special Inspector.
 - a. Contractor to coordinate scheduling of Owner's Special Inspector.
 - b. Provide minimum 24 HR notice to Owner's Special Inspector.
 - c. Reimburse Owner for non-productive time incurred by Owner's Special Inspector if production sampling and testing event it delayed, interrupted, extended or aborted due to factors within the control of the Contractor.
- B. Duties and Authorities of Testing Agency/Service Provider:
1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.
 2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.
 3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.
 - a. All test reports to include exact location in the work at which batch represented by a test was deposited.
 - b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
 4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 2. ASTM International (ASTM):
 - a. ASTM Cement and Concrete Reference Laboratory (CCRL).
 - b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - e. C94, Standard Specification for Ready-Mixed Concrete.
 - f. C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - g. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - h. C157 Standard Test Method for Length Change of Hardened Hydraulic-CementMortar and Concrete.
 - i. C172, Standard Practice for Sampling Freshly Mixed Concrete.
 - j. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - k. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - l. C1019, Standard Test Method for Sampling and Testing Grout.

- m. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
 - n. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- B. Qualifications:
- 1. Contractor's Testing Agency:
 - a. Meeting requirements of ASTM E329 and ASTM C94.
 - b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.
- C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

1.4 DEFINITIONS

- A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

1.5 SUBMITTALS

- A. Shop Drawings:
- 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Concrete materials and concrete mix designs proposed for use.
 - 1) Include results of all testing performed to qualify materials and to establish mix designs.
 - 2) Place no concrete until approval of mix designs has been received in writing.
 - 3) Submittal for each concrete mix design to include:
 - a) Sieve analysis and source of fine and coarse aggregates.
 - b) Test for aggregate organic impurities.
 - c) Proportioning of all materials.
 - d) Type of cement with mill certificate for the cement.
 - e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
 - f) Slump.
 - g) Brand, type and quantity of air entrainment and any other proposed admixtures.
 - h) Shrinkage test results.
 - i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
 - j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.
 - 3. Certifications:
 - a. Testing Agency qualifications.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY

- A. The following concrete testing will be performed by the Service Provider/Testing Agency:
- 1. Concrete strength testing:
 - a. Secure concrete samples in accordance with ASTM C172.

- 1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
 - b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
 - 1) Record any deviations from requirements on test report.
 - 2) Cylinder size: Per ASTM C31.
 - a) 4 IN cylinders shall not be used for concrete mixes with maximum aggregate size larger than 1 IN.
 - b) Use the same size cylinder for all tests for each concrete mix.
 - 3) Quantity:
 - a) 6 IN DIA by 12 IN high: Four cylinders.
 - b) 4 IN DIA by 8 IN high: Six cylinders.
 - c. Field cure one cylinder for the seven day test.
 - 1) Laboratory cure the remaining.
 - d. Test cylinders in accordance with ASTM C39.
 - 1) 6 IN DIA cylinders:
 - a) Test two cylinders at 28 days for strength test result and the one field cured sample at seven days for information.
 - b) Hold remaining cylinder in reserve.
 - 2) 4 IN DIA cylinders:
 - a) Test three cylinders at 28 days for strength test result and the one field cured cylinder at seven days for information.
 - b) Hold remaining cylinders in reserve.
 - e. Strength test result:
 - 1) Average of strengths of two, 6 IN DIA cylinders or three, 4 IN DIA cylinders from the same sample tested at 28 days.
 - 2) If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
 - 3) Should all cylinders in any test show any of above defects, discard entire test.
 - f. Frequency of tests:
 - 1) Concrete sand cement grout: One strength test for each 4 HR period of grout placement or fraction thereof.
 - a) Test grout in accordance with ASTM C1019.
 - 2) Concrete topping, concrete fill and lean concrete: One strength test for each 10 CUYD of each type of concrete or fraction thereof placed.
 - 3) Precast concrete: Frequency per Specification Section 03 41 33.
 - 4) All other concrete:
 - a) One strength test to be taken not less than once a day, nor less than once for each 60 CUYD or fraction thereof placed in any one day.
 - b) Once for each 5000 SQFT of slab or wall surface area placed each day
 - c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five strength tests for each concrete mix, tests shall then be made from at least five randomly selected batches or from each batch if fewer than five batches are provided.
2. Slump testing:
 - a. Determine slump of concrete sample for each strength test.
 - 1) Determine slump in accordance with ASTM C143.
 - b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
 - 1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.
 3. Air content testing: Determine air content of concrete sample for each strength test in accordance with either ASTM C231, ASTM C173, or ASTM C138.

4. Temperature testing: Determine temperature of concrete sample for each strength test.
5. In-place concrete testing (if required).

3.2 SPECIAL INSPECTIONS

- A. See Section 01 45 33.
 1. Special Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
 2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
- B. Formwork Special Inspections:
 1. Shape, location, and dimensions.
 - a. Inspect in accordance with dimensions and details on Drawings.
 - b. Frequency: Inspect prior to each concrete pour.
- C. Reinforcing Special Inspections:
 1. Reinforcing size, spacing, lap length and concrete cover.
 - a. Inspect in accordance with Drawings and Specification.
 - b. Frequency: Inspect prior to each concrete pour.
 2. Reinforcing adhesive anchoring system:
 - a. Inspect in accordance with ICC-ES report.
 - b. Frequency:
 - 1) Inspect all adhesive anchors for the first 4 HRS of installation.
 - 2) Inspect approximately 25 PCT of adhesive anchors thereafter.
 - 3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
 3. Mechanical splices:
 - a. Inspect in accordance with ICC-ES report.
 - b. Frequency:
 - 1) Inspect all mechanical splices prior to placing concrete.
 - 2) Additional inspection will be required for different installer or if the quality of installation appears to vary.
- D. Mixing, Placing, Jointing, and Curing Special Inspections:
 1. Perform concrete tests per the requirements of this Specification Section.
 2. Verification of proper mix design.
 - a. Frequency: Periodically, prior to each concrete pour.
 3. Proper concrete placement techniques.
 - a. Inspect per requirements of Section 03 31 31.
 - b. Frequency: During each concrete pour.
 4. Proper curing temperature and techniques.
 - a. Inspect per requirements of Section 03 31 31.
 - b. Frequency: Periodically, but not less than every third day.
 5. Joints:
 - a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
 - b. Frequency: Prior to each concrete pour.
 6. Waterstops:
 - a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.
 - b. Frequency:
 - 1) Prior to each concrete pour.
- E. Anchorage to Concrete Special Inspection:
 1. Post installed anchors as required by the Building Code, ICC-ES Evaluation Reports, and as specified by the Engineer.
 - a. Frequency: Per ICC-ES Report.

2. Cast-in-place concrete anchors, including anchor size, embedment, material and location.
 - a. Frequency: Prior to each concrete pour.

3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

- A. To facilitate testing and inspection, perform the following:
 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
 3. Take samples at point of placement into concrete member.
- B. Notify Engineer, and Owner's Testing Agency, and Contractor's Testing Agency sufficiently in advance of operations (minimum of 24 HRS) to allow for assignment of personnel and for scheduled completion of quality tests.

3.4 ACCEPTANCE

- A. Completed concrete work which meets applicable requirements will be accepted without qualification.
- B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
- C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
 1. In this event, modifications may be required to assure that concrete work complies with requirements.
 2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.
- D. Dimensional Tolerances:
 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
 - a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
 3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
 4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
 - a. Repair or remove and replace if required.
 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
 - a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.
- E. Appearance:
 1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
 2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.
- F. High Water-Cement Ratio:
 1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.

2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.
- G. Strength of Structure:
1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
 - a. Low concrete strength:
 - 1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
 - a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
 - b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests.
 - c) A strength test shall be the average of two, 6 IN diameter cylinders or three, 4 IN diameter cylinders from the same sample tested at 28 days.
 - 2) Acceptance:
 - a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
 - (1) Average of all sets of three consecutive strength tests equal or exceed the required specified 28 day compressive strength.
 - (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 PSI.
 - b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 21 00 or requirements of the Contract Drawings or approved Shop Drawings.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
 - d. Curing time and procedure not meeting requirements of this Specification Section.
 - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
 - g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.
 2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
 3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
 - a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
 - 1) Such tests shall not be used as a basis for acceptance or rejection.
 - b. Core tests:
 - 1) Where required, test cores will be obtained in accordance with ASTM C42.
 - a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 DEGF, relative humidity less than 60 PCT) for seven days before test then test dry.
 - b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 HRS and test wet.
 - c) Testing wet or dry to be determined by Engineer.
 - 2) Three representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.

- a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
- b) If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
- 3) Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85 PCT of specified strength and no single core is less than 75 PCT of specified strength.
- 4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.
- 4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
- 5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
- 6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

H. Shrinkage Tests:

- 1. Shrinkage tests shall be performed on all concrete with specified shrinkage limits in Specification Section 03 31 30. Shrinkage tests are required for mix design approval and for approval of concrete in the field.
 - a. Mix design shrinkage test:
 - 1) The submitted mix design proportions must be the same proportions used for the laboratory mix design shrinkage test and shall indicate concrete meets the specified shrinkage limit.
 - 2) Compressive strength test specimens shall be taken from each concrete sample used to prepare the shrinkage specimens. These compression test specimens shall be considered as part of the normal requirements for tests on this project.
 - 3) Drying shrinkage for laboratory cast specimens for mix design approval shall conform to ASTM C157, modified as follows:
 - a) Curing of specimens:
 - (1) Remove specimens from molds at an age of $23 \frac{1}{2} \pm \frac{1}{2}$ hours after the addition of water to the cement during the mixing operation.
 - (2) Upon removal of the specimens from the molds, immerse them in lime-saturated water maintained at 73 ± 1 degrees F for a minimum of 30 minutes.
 - (3) At an age of $24 \pm \frac{1}{2}$ hours after the addition of water to the cement during the mixing operation, remove the specimens from water storage one at a time, wipe with a damp cloth, and immediately take the original length (not to be confused with "base length").
 - (4) After measuring the original length, store the specimens in lime-saturated water at 73 ± 3 degrees F until they have reached an age of 7 days, including the period in the molds.
 - b) At the end of the curing period, take a second measurement after the specimens have been brought to a more closely controlled temperature as was done prior to the first measurement. This measurement shall be the base length for shrinkage calculations ("zero" days drying age) and shall be expressed as a percentage of original length (expansion).
 - c) Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 ± 3 degrees F and 50 ± 4 percent relative humidity, for the remainder of the test. Specimens to have a clearance of at least 1 IN on all sides.

- d) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at “zero” days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage;
 - e) Make and report shrinkage measurements separately for 7, 14, 21, and 28 days of drying after the 7 day curing period.
- b. Field shrinkage tests:
- 1) Field test shrinkage specimens shall be taken on the first concrete placement of each class of concrete.
 - 2) Compressive strength test specimens shall be taken from each concrete sample used to prepare the shrinkage specimens. These compression test specimens shall be considered as part of the normal requirements for tests on this project.
 - 3) If excessive cracking or other symptoms that are potentially related to shrinkage occur during construction, Engineer may require up to two (2) additional field shrinkage tests during construction to verify compliance with these Specifications.
 - 4) The initial field shrinkage testing will establish a baseline for the shrinkage of the specified mixes that represents the concrete as placed and cured in the field.
 - 5) The field cast specimens shall be transported to a facility that can provide temperature and humidity control prior to removing them from the molds.
 - 6) Drying shrinkage for specimens cast in the field shall conform to ASTM C157, modified as follows:
 - a) Curing of specimens:
 - (1) Remove specimens from molds at an age of $23 \frac{1}{2} \pm \frac{1}{2}$ hours after the addition of water to the cement during the mixing operation.
 - (2) Upon removal of the specimens from the molds, immerse them in lime-saturated water maintained at 73 ± 1 degrees F for a minimum of 30 minutes.
 - (3) At an age of $24 \pm \frac{1}{2}$ hours after the addition of water to the cement during the mixing operation, remove the specimens from water storage one at a time, wipe with a damp cloth, and immediately take the original length (not to be confused with “base length”).
 - (4) After measuring the original length, continue curing the specimens, with the same curing methods used in the field, until they have reached an age of 14 days, including the period in the molds.
 - b) At the end of the curing period, store the specimens in a temperature- and humidity-controlled room maintained at 73 ± 3 degrees F and 50 ± 4 percent relative humidity, for the remainder of the test. Specimens to have a clearance of at least 1 IN on all sides.
 - c) Take a second measurement immediately after the specimens temperature has stabilized. This measurement shall be the base length for shrinkage calculations (“zero” days drying age) and shall be expressed as a percentage of original length (expansion).
 - d) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at “zero” days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage;

- e) Make and report shrinkage measurements separately for 7, 14, 21, and 28 days of drying after the 14 day curing period.
- 2. Shrinkage specimens shall be fabricated, cured, dried, and measured in accordance with ASTM C157 and as modified herein. All specimens shall be 11-1/4 IN \pm 1/8 IN for an effective gauge length of 10 IN.
 - a. Shrinkage specimens for mixes with 100 PCT of the aggregate passing the 1 IN sieve shall be 3 IN by 3 IN in cross section.
 - b. For mixes with aggregates larger than 1 IN and with 100 PCT passing a 2 IN sieve, drying shrinkage specimens shall be 4 IN by 4 IN in cross section.
- 3. Report shrinkage test results at intervals as specified for the type of test, either laboratory or field, according to ASTM C157 and the type of storage, water or air respectively.
 - a. The field test shrinkage shall not exceed the laboratory mix shrinkage requirement by more than 50 PCT on the initial placement of each class of concrete required to be shrinkage tested.
 - b. If the required field shrinkage limitation is not met, all aspects of concrete mixing, placing, sampling and curing will be subject to review. If this review points toward a solution, participate in a solution of making changes as required to establish compliance. These changes may include, but are necessarily limited to the following:
 - 1) Changing the curing methods.
 - 2) Changing the source of aggregates.
 - 3) Changing the amount of crushed or fractured coarse aggregate.
 - 4) Changing cement quantity and/or admixtures.
 - 5) Use of a shrinkage reducing admixture.
 - 6) Reducing water/cement ratio.
 - 7) Making changes to sampling practices
 - 8) Possible consideration by the Engineer of modifying the field shrinkage acceptance criteria.
 - 9) Other actions designed to minimize shrinkage and to provide better quality assurance.
- 4. Once the initial field shrinkage testing requirement is met, subsequent shrinkage testing, done, if needed, during the remainder of the construction period shall use the field test result from each initial field shrinkage test as a base line for acceptance.
 - a. If the base line acceptance criteria is not met, then the provisions of Paragraph 3.3 H.3.b above shall be enacted to re-establish compliance.

END OF SECTION

SECTION 03 11 13

FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork requirements for concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 5. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 347R, Guide to Formwork for Concrete.
 - 2. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
 - 1. Formwork, shoring and reshoring to be designed by a licensed professional engineer currently registered or having a minimum of three years of experience in this type of design work.
 - a. Above qualifications apply to slabs and beams not cast on the ground.
- C. Miscellaneous:
 - 1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
 - 2. Design requirements:
 - a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local Building Code.
 - 1) Where conflicts occur between the above two standards, the more stringent requirements shall govern.
 - b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.
 - 3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal of shores and installation of reshores and for calculating the loads transferred to the structure during this process in accordance with ACI 347R.
 - a. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon. Calculations shall be performed by a licensed professional engineer.
 - b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction:
 - 1) The structural system that exists.

- 2) Effects of all loads during construction.
- 3) Strength of concrete.
- 4) The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads.
- 5) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.
- 6) Any other loading or condition that affects the safety or serviceability of the structure during construction.

1.3 DEFINITIONS

- A. Words and terms used in these Specifications are defined in ACI CT-13.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for the requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer and type of proposed form materials.
 - d. Manufacturer and type of proposed form ties.
 - e. Manufacturer and type of proposed form release material.
- B. Samples:
1. A 12 IN SQ sample of each of the following form finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Stay-in-place forms:
 - a. Alabama Metal Industries Corporation.
 - b. Or equal.

2.2 MATERIALS

- A. Forms for Surfaces Exposed to View:
1. Wood forms:
 - a. 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
 - b. Built-in-place or prefabricated type panel.
 2. Metal forms:
 - a. Metal forms may be used except for aluminum in contact with concrete.
 - b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
- B. Forms for Surfaces Not Exposed to View:
1. Wood or metal sufficiently tight to prevent leakage.
 2. Do not use aluminum forms.

2.3 ACCESSORIES

- A. Form Ties:
1. Commercially fabricated for use in form construction.
 - a. Field fabricated ties are unacceptable.

2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
 3. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.
 4. Cone size:
 - a. 3/4 IN minimum diameter cones on both ends.
 - b. Depth of cone not to exceed the concrete reinforcing cover.
 5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid during plant operation or below grade soil.
 6. Through-wall ties that are designed to be entirely removed are not allowed in all walls that will be in contact with process liquid during plant operation.
- B. Stay-In-Place Forms:
1. Ribbed expanded metal leave-in-place concrete forms commercially fabricated to provide an intentionally rougher surface.
 2. Hot-dipped galvanized.
 3. Stay-in-place forms shall be sized to support wet concrete for the span and thickness indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Form Surface Treatment:
1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved release material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
 - a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
 2. Do not allow excess form release material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
- B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.
- C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

- A. Install products in accordance with manufacturer's instructions.
- B. Tolerances:
1. Conform to ACI 117.
 2. Variation from plumb:
 - a. In lines and surfaces of columns, piers, walls, and in risers.
 - 1) Maximum in any 10 FT of height: 1/4 IN.
 - 2) Maximum for entire height: 1/2 IN.
 - b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
 - 1) Maximum in any 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
 3. Variation from level or from grades specified:
 - a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.

- 1) Maximum in any 10 FT of length: 1/4 IN.
 - 2) Maximum in any bay or in any 20 FT length: 3/8 IN.
 - 3) Maximum for entire length: 3/4 IN.
 - b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
 - 1) Maximum in any bay or in 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
 4. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
 - a. Maximum in any bay: 1/2 IN.
 - b. Maximum in any 20 FT of length: 1/2 IN.
 - c. Maximum for entire length: 1 IN.
 5. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 IN.
 6. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 IN.
 7. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.
 8. Footings and foundations:
 - a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
 - b. Misplacement or eccentricity:
 - 1) 2 PCT of footing width in direction of misplacement but not more than 2 IN.
 - c. Thickness:
 - 1) Decrease in specified thickness: 5 PCT.
 - 2) Increase in specified thickness: No limit except that which may interfere with other construction.
 9. Variation in steps:
 - a. In a flight of stairs:
 - 1) Rise: +1/8 IN.
 - 2) Tread: +1/4 IN.
 - b. In consecutive steps:
 - 1) Rise: +1/16 IN.
 - 2) Tread: +1/8 IN.
 10. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
 11. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
 12. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.
- C. Make forms sufficiently tight to prevent loss of mortar from concrete.
- D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.
- E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN.
1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
 2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.
- F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 FT wide.
1. Brace and tie formwork to maintain correct position and shape of members.

- G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.
- H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.
- I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.
- J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
 - 1. Securely brace forms against lateral deflection.
 - 2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.
- K. Stay-In-Place Forms:
 - 1. Support stay-in-place forms as required to maintain the formwork in proper position.
 - 2. Hold the edge of stay-in-place forms back a minimum of 2 IN from all smooth formed concrete surfaces.
 - 3. Stay-in-place forms may be used at the Contractor's option at:
 - a. Surfaces that will be backfilled with soil.
 - 1) Maintain a minimum of 3 IN of concrete cover over all reinforcing.
 - b. Roughened construction joints.
 - c. Other locations approved by Engineer.

3.3 REMOVAL OF FORMS

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
 - 1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03 31 31.
- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
 - 1. For walls of water containing structures, leave forms in place for a minimum of 48 HRS.
- F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28 day compressive strength.
 - 1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.4 RESHORING

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with

remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

- B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.
- C. During reshoring do not subject concrete in structural members to combined dead and construction loads in excess of loads that structural members can adequately support.
- D. Place reshores as soon as practicable after stripping operations are complete but in no case later than end of working day on which stripping occurs.
- E. Tighten reshores to carry their required loads without overstressing.
- F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. For floors supporting shores under newly placed concrete leave original supporting shores in place or reshore.
 - 1. Reshoring system shall have a capacity sufficient to resist anticipated loads.
 - 2. Locate reshores directly under a shore position above.
- H. In multi-story buildings, extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

3.5 FIELD QUALITY CONTROL

- A. Special Inspection:
 - 1. See Section 01 45 33.
 - 2. See Section 03 05 05.
 - 3. Special Inspection is required for:
 - a. Shape, location, and dimensions.
 - 1) Inspect in accordance with dimensions and details on Drawings
 - 2) Frequency: Inspect periodically, prior to each concrete pour.

END OF SECTION

SECTION 03 15 19
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for all cast-in-place anchor bolts, anchor rods, reinforcing adhesive anchorage, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
 2. Design of all concrete anchors not indicated on the Drawings including, but not limited to, installation of anchors into concrete for the following structural and nonstructural components:
 - a. Structural members and accessories.
 - b. Metal, wood, and plastic fabrications.
 - c. Architectural components.
 - d. Mechanical and electrical equipment and components.
 - e. Plumbing, piping, and HVAC work.
 - f. All other components requiring attachment to concrete.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 03 05 05 - Concrete Testing and Inspection.
 4. Section 09 96 00 - High Performance Industrial Coatings.
 5. Section 40 05 07 - Pipe Support Systems.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete and Commentary.
 - b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
 - a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
 3. American Institute of Steel Construction (AISC):
 - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
 4. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - d. A153, Standard Specification 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. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - i. F436, Standard Specification for Hardened Steel Washers.
 - j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - k. F594, Standard Specification for Stainless Steel Nuts.

- l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 - m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
 - 5. ICC Evaluation Service (ICC-ES):
 - a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
 - 6. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
- 1. Anchor designer for Contractor-designed post-installed anchors shall be a professional engineer licensed in the State that the Project is located in.
 - 2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.
- C. Post-installed anchors and related materials shall be listed by the following agencies:
- 1. ICC-ES.
 - 2. Engineer approved equivalent.

1.3 DEFINITIONS

- A. Adhesive Anchors:
- 1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
 - 2. Includes anchors using acrylics, epoxy and other similar adhesives.
- B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.
- C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.
- D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.
- E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- F. Hardware: As defined in ASTM A153.
- G. Installer or Applicator:
- 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- H. MPII: Manufacturer's printed installation instructions.
- I. Mechanical Anchors:
- 1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
 - 2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
 - 3. Drop-in anchors and other similar anchors are not allowed.
- J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that submitted products meet requirements of referenced standards.
 - b. Manufacturer material data sheet for each anchor.
 - 1) Clearly indicate which products on the data sheet are proposed for use on the Project.
 - c. Manufacturer's printed installation instructions.
 - d. Current ICC-ES report for each post-installed anchor system indicating the following:
 - 1) Certification that anchors meet all requirements indicated in this Specification.
 - 2) Performance data showing that anchor is approved for use in cracked concrete.
 - 3) Seismic design categories for which anchor system has been approved.
 - 4) Required installation procedures.
 - 5) Special inspection requirements for installation.
 - e. Anchorage layout drawings and details:
 - 1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
 - 2) Drawings showing location, configuration, spacing and edge distance.
 - f. Contractor Designed Post-Installed Anchors:
 - 1) Show diameter and embedment depth of each anchor.
 - 2) Indicate compliance with ACI 318, Chapter 17.
 - 3) Design tension and shear loads used for anchor design.
 - 4) Engineering design calculations:
 - a) Indicate design load to each anchor.
 - b) When the design load is not indicated on Drawings, include calculations to develop anchor forces based on Design Criteria listed herein.
 - c) Sealed and signed by contractor's professional engineer.
 - d) Calculations will be submitted for information purposes only.
 - 5) Type of post-installed anchor system used.
 - a) Provide manufacturer's ICC-ES report for the following:
 - (1) Mechanical anchorage per ICC-ES AC193.
 - (2) Adhesive anchorage per ICC-ES AC308.

B. Samples:

1. Representative samples of concrete anchors may be requested by Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

C. Informational Submittals:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Certification of qualifications for each installer of post-installed anchors.
 - a. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.
 - b. Provide one of the following for each type of anchor, as required by this specification section:
 - 1) Letter from manufacturer documenting successful training completion.
 - 2) Certification of completion for Engineer approved program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged and complete with installation instructions.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

- C. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cast-in-place Concrete Anchors:
 - 1. Building, nonbuilding structures, and equipment:
 - a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized or non-galvanized threaded rods.
 - b. ASTM A307, Grade A for galvanized headed bolts.
 - 2. All other cast-in-place concrete anchors:
 - a. Stainless steel with matching nut and washer.
 - b. Submerged application: ASTM F593, Type 316.
 - c. Non-submerged application: ASTM F593, Type 304 or Type 316.
- B. Post-Installed Mechanical and Adhesive Concrete Anchors:
 - 1. Stainless steel with matching nut and washer.
 - 2. Submerged application: ASTM F593, Type 316.
 - 3. Non-submerged application: ASTM F593, Type 304 or Type 316.
- C. Reinforcement: See Section 03 21 00.
- D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.
- E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.
- F. Washers:
 - 1. ASTM F436 unless noted otherwise.
 - 2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
 - 3. Plate washers: Minimum 1/2 IN thick fabricated ASTM A36 square plates as required.
 - 4. Follow manufacturer's requirements for all post-installed anchorage.
- G. Nuts:
 - 1. ASTM A563 for all cast-in-place anchorage.
 - 2. If stainless steel anchorage is being used for cast-in-place anchorage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
 - 3. Follow manufacturer's requirements if using post-installed anchorage.
- H. Galvanizing Repair Paint:
 - 1. High zinc dust content paint for regalvanizing welds and abrasions.
 - 2. ASTM A780.
 - 3. Zinc content: Minimum 92 PCT in dry film.
 - 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."
- I. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.2 CONTRACTOR DESIGNED ANCHORAGE

- A. Manufacturers:
 - 1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Engineer.
 - a. Hilti.
 - b. Dewalt.

- c. Simpson Strong-Tie.
 - d. Or equal.
- B. Design the anchorage when any of the following occur:
- 1. Design load for concrete anchorage is shown on the Drawings.
 - 2. When specifically required by the Contract Documents.
 - 3. When an anchorage is required but not specified in the Drawings.
 - 4. When anchorage is shown on Drawings other than Structural Drawings.
- C. Anchorage Design Loads:
- 1. Determine all of the design loads, including wind and seismic loads, per the Building Code.
 - a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.
- D. When Contract Drawings, other than the Structural Drawings, indicate an anchor diameter or length, the Contractor design shall incorporate these as “minimums.”
- E. Cast-in-Place Concrete Anchors:
- 1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the Building Code including ACI 318, Chapter 17.
 - 2. Design assuming cracked concrete.
- F. Post-installed Concrete Anchors:
- 1. Provide the manufacturer’s system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified or calculated load based on requirements given in the Building Code, ACI 318, ACI 350 and current ICC-ES report, for the anchor to be used.
 - 2. Design assuming cracked concrete.

2.3 ENGINEER DESIGNED ANCHORAGE

- A. When the size, length and details of anchorages are shown on Contract Structural Drawings, Contractor design of anchorage is not required unless otherwise indicated.
- B. Manufacturers:
- 1. Additional newer post-installed anchor systems for the listed manufacturers will be considered only if a current evaluation agency report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section, the anchor system is certified by ICC-ES for cracked concrete conditions, and if approved by the Engineer.
 - 2. Mechanical Anchors:
 - a. Hilti:
 - 1) Kwik Bolt TZ (ICC-ES ESR-1917).
 - 2) Or equal.
 - 3. Adhesive Concrete Anchors:
 - a. Hilti:
 - 1) HIT RE 500 V3 (ICC ESR-3814).
 - 2) Or equal.
 - 4. Concrete Screw Anchors:
 - a. Hilti:
 - 1) Kwik HUS-EZ Screw (ICC-ES ESR-3027).
 - 2) Or equal.
 - 5. Submit request for substitution in accordance with Specification Section 01 25 00.
 - a. Substitution request to indicate the proposed anchor has the at least the same tension and shear strength as the specified anchor installed as indicated in the Contract Drawings.
 - b. Calculations to be stamped by a Professional Engineer registered in the state that the Project is located in.

PART 3 - EXECUTION

3.1 GENERAL

- A. Cast-in-Place Anchorage:
 - 1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Engineer.
 - 2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.
- B. Adhesive Anchorage:
 - 1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
 - 2. May be used where subjected to vibration or where buried or submerged.
 - 3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.
 - 4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- C. Mechanical Anchorage:
 - 1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
 - 2. Do not use where subjected to vibration.
 - 3. May be used in overhead applications.
 - 4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Engineer or specified in Contract Documents.

3.2 PREPARATION

- A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.
- B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
 - 1. Notify Engineer of conditions detrimental to proper and timely completion of work.
 - 2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
- C. Special Inspection is required in accordance with the Building Code for all concrete anchorage.
 - 1. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
 - 2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.
- D. Post-installed anchor manufacturer's representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
 - 1. Follow such procedures to assure acceptable installation.
 - 2. Adhesive anchors must be installed in concrete aged a minimum of 21 days.

3.3 INSTALLATION

- A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
 - 1. Tack welding of anchorage is prohibited.
 - 2. Coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
 - 3. Anchorage location tolerance shall be in accordance with AISC 303.
 - 4. Provide steel or durable wood templates for all column and equipment anchorage.

- a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.
- B. Unless noted or specified otherwise:
 - 1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
 - a. Provide dissimilar materials protection per Specification Section 09 96 00.
 - 2. Provide washers for all anchorage.
 - 3. Where exposed, extend threaded anchorage a maximum of 3/4 IN and a minimum of 1/2 IN above the top of the fully engaged nut.
 - a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.
- C. Do the following after nuts are snug-tightened down:
 - 1. If using post-installed anchorage, follow MPII.
 - 2. Upset threads of anchorage to prevent nuts from backing off.
 - a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
 - 3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn to prevent nuts from backing off.
 - 4. If two nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two nuts together.
 - 5. If using post-installed anchorage, follow manufacturer's installation procedures.
- D. Assure that embedded items are protected from damage and are not filled in with concrete.
- E. Secure architectural components such that it will not be aesthetically distorted nor fasteners overstressed from expansion, contraction or installation.
- F. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.
- G. Repair damaged galvanized surfaces in accordance with ASTM A780.
 - 1. Prepare damaged surfaces by abrasive blasting or power sanding.
 - 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.
- H. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
 - 1. Use hammer drills to create holes.
 - 2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Special Inspector.

3.4 FIELD QUALITY CONTROL

- A. Special Inspection:
 - 1. See Section 01 45 33.
 - 2. See Section 03 05 05.

3.5 CLEANING

- A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.
- B. Provide surface acceptable to receive field applied paint coatings when specified in Specification Section 09 96 00.

END OF SECTION

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SECTION 03 21 00 REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bar requirements for concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 15 19 - Anchorage to Concrete.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. SP 66, ACI Detailing Manual.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - d. 318, Building Code Requirements for Structural Concrete.
 - e. 350, Code Requirements for Environmental Engineering Concrete Structures.
 - 2. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - e. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 3. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Mill certificates for all reinforcing.
 - d. Manufacturer and type of proprietary reinforcing mechanical splices.
 - 3. Qualifications of welding operators, welding processes and procedures.
 - 4. Reinforcing number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing supports.
 - 5. Sufficient reinforcing details to permit installation of reinforcing.
 - 6. Reinforcing details in accordance with ACI SP 66 and ACI 315.
 - 7. Locations where proprietary reinforcing mechanical splices are required or proposed for use.
 - 8. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.

- a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.
- b. Where multiple types of supports for reinforcing steel (such as chairs, runners, bolsters, and other types of supports) will be used in the Work, clearly indicate on the Shop Drawings the support types and materials of supports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Support and store all reinforcing above ground.
- B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Reinforcing adhesive anchors:
 - a. See Specification Section 03 15 19.
 2. Reinforcing mechanical splices:
 - a. Lenton Rebar Splicing by Erico, Inc.
 - b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
 - c. Bar-Grip Systems by Barsplice Products, Inc.
 - d. Or equal.

2.2 MATERIALS

- A. Reinforcing Bars: ASTM A615, grade 60, deformed.
- B. Reinforcing Bars to be Welded: ASTM A706, Grade 60, deformed.
- C. Welded Wire Reinforcement: ASTM A1064.
- D. Smooth Dowel Bars:
 1. Water containing structures: ASTM A276, Type 316.
 2. All other locations: ASTM A36, with metal end cap to allow longitudinal movement equal to joint width plus 1 IN.
- E. Proprietary Reinforcing Mechanical Splices: To develop in tension and compression a minimum of 125 PCT of the yield strength of the reinforcing bars being spliced.
- F. Reinforcing Adhesive Anchors:
 1. See Specification 03 15 19.

2.3 ACCESSORIES

- A. Chairs, Runners, Bolsters, Spacers, Hangers, and Other Reinforcing Supports:
 1. Metal fabrications with plastic-coated tips in contact with forms.
 - a. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
 2. All plastic construction meeting the requirements of CRSI Manual of Standard Practice.
 - a. 100 PCT non-metallic, non-corrosive.
 - b. Required for all walls and elevated construction exposed to liquid containing structures.
- B. Protective plastic caps at mechanical splices.

2.4 FABRICATION

- A. Tolerances:

1. Conforms to ACI 117, except as modified herein.
 2. Sheared lengths: +1 IN.
 3. Overall dimensions of stirrups, ties and spirals: +1/2 IN.
 4. All other bends: +0 IN, -1/2 IN.
- B. Minimum diameter of bends measured on the inside of the reinforcing bar to be as indicated in ACI 318 Paragraph 7.2.
- C. Ship reinforcing to jobsite with attached plastic or metal tags.
1. Place on each tag the mark number of the reinforcing corresponding to the mark number indicated on the Shop Drawing.
 2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Tolerances:
1. Conform to ACI 117, except as modified herein.
 2. Reinforcing placement:
 - a. Clear distance to formed surfaces: +1/4 IN.
 - b. Minimum spacing between bars: -1/4 IN.
 - c. Top bars in slabs and beams:
 - 1) Members 8 IN deep or less: +1/4 IN.
 - 2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
 - 3) Members more than 2 FT deep: -1/4 IN, +1 IN.
 - d. Crosswise of members: Spaced evenly within +1 IN.
 - e. Lengthwise of members: +2 IN.
 3. Minimum clear distances between reinforcing bars:
 - a. Beams, walls and slabs: Distance equal to bar diameter or 1 IN, whichever is greater.
 - b. Columns: Distance equal to 1-1/2 times the bar diameter or 1-1/2 IN, whichever is greater.
 - c. Beam and slab reinforcing shall be threaded through the column vertical rebars without displacing the column vertical bars and still maintaining the clear distances required for the beam and slab reinforcing bars.
- B. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
1. For reinforcing: Class B splice meeting the requirements of ACI 318 or ACI 350.
 2. For welded wire reinforcement:
 - a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 IN, nor less than 1.5 x development length nor less than 6 IN.
 - b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with ACI 318 or ACI 350.
 3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.
 - a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.
- D. Welding:
1. Welding reinforcing is only permitted where indicated on the Drawings.
- E. Placing Reinforcing:
1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.

2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the reinforcing supplied.
3. Reinforcing support:
 - a. Uncoated reinforcing:
 - 1) Support reinforcing and fasten together to prevent displacement by construction operations.
 - a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
 - c) Reinforcement shown on the Contract Documents may not be repositioned for use a support for reinforcement. Additional drop bars may be provided for support of reinforcing,
 - 2) Reinforcing supported on ground:
 - a) Slab on grade and other members with only one mat of reinforcing:
 - (1) Provide metal bar supports with bottom plate.
 - (2) Do not use concrete blocks to support slab-on-grade reinforcing.
 - b) All other members: Provide supporting concrete blocks or metal bar supports with bottom plate.
 - 3) Reinforcing supported on formwork:
 - a) Concrete surfaces in contact with or over process liquid: All-Plastic chairs, runners and bar supports.
 - b) All other formed surfaces:
 - (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other reinforcing support.
 - (2) Only tips in contact with the forms need to be plastic coated.
4. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers to be 1 IN.
 - a. Place spacer bars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
5. Extend reinforcement to within 2 IN of concrete perimeter edges.
 - a. If perimeter edge is formed by earth or stay-in-place forms, extend reinforcement to within 3 IN of the edge.
6. To assure proper placement, furnish templates for all column vertical bars and dowels.
7. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
 - a. Do not bend reinforcing by means of heat.
8. Do not tack weld reinforcing.
9. Embed reinforcing into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
 - a. See Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

- A. Reinforcement Congestion and Interferences:
 1. Notify Engineer whenever the specified clearances between bars cannot be met.
 2. Do not place any concrete until the Engineer submits a solution to reinforcing congestion problem.
 3. Reinforcing may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
 4. If bars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of reinforcing.
 5. No cutting of reinforcing shall be done without written approval of Engineer.

- B. Special Inspection:
1. See Section 01 45 33.
 2. See Section 03 05 05.

END OF SECTION

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SECTION 03 31 30
CONCRETE, MATERIALS AND PROPORTIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete materials, strengths and proportioning for concrete work.
 - 2. Grouting:
 - a. Base plates for columns and equipment.
 - b. As specified and indicated in the Contract Document.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 15 19 - Anchorage to Concrete.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 6. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
 - 7. Section 03 41 33 - Precast and Prestressed Concrete.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - c. 212.3R, Chemical Admixtures for Concrete.
 - d. 232.2R, Use of Fly Ash in Concrete.
 - e. 318, Building Code Requirements for Structural Concrete.
 - f. 350, Code Requirements for Environmental Engineering Concrete Structures.
 - 2. ASTM International (ASTM):
 - a. C33, Standard Specification for Concrete Aggregates.
 - b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - d. C150, Standard Specification for Portland Cement.
 - e. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
 - f. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - h. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
 - i. C494, Standard Specification for Chemical Admixtures for Concrete.
 - j. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - k. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
 - l. C1116, Standard Specification for Fiber-Reinforced Concrete.
 - m. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

- n. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
- o. C1399, Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete.
- p. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
- q. C1609, Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).
- 3. Steel Deck Institute (SDI):
 - a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.

1.3 DEFINITIONS

- A. Words and terms used in these Specifications are defined in ACI CT-13.
- B. Water-Bearing Concrete: Any concrete surface to be in contact with process fluids during normal operation of the facility, including, but not limited to, tank, channels, wet wells and distribution chambers.
- C. Supplementary Cementitious Materials (SCM): Fly ash, silica fume and ground granulated blast furnace slag.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's instructions.
 - c. Concrete mix designs as required by Specification Section 03 05 05.
 - d. Manufacturer and type of proposed admixtures.
 - e. Manufacturer and type of proposed non-shrink grout and grout cure/seal compound.
 - 3. Certifications:
 - a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
 - b. Certification that the SCM meet the quality requirements stated in this Specification Section, and SCM supplier's certified test reports for each shipment of SCM delivered to concrete supplier.
 - c. Certification that the class of coarse aggregate meets the requirements of ASTM C33 for type and location of concrete construction.
 - d. Certification of aggregate gradation.
 - e. Certification of coarse aggregate impurities as relates to alkali-silica reactivity per ASTM C33, Appendix X.
 - f. Certification of shrinkage test results.
 - 4. Test reports:
 - a. Cement and SCM mill reports for all cement to be supplied.
 - b. Provide test results for alkali-silica reactive impurities on coarse aggregates per referenced ASTM standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials:
 - 1. Store cement and SCM in weathertight buildings, bins, or silos which will exclude moisture and contaminants.
 - 2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates.

3. Allow natural sand to drain until it has reached a relatively uniform moisture content before use.
4. Do not use frozen or partially frozen aggregates.
5. Do not use bottom 6 IN layer of stockpiled material in contact with ground.
6. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
 - a. For those used in form of suspensions or non-stable solutions, provide agitating equipment to assure thorough distribution of ingredients.
 - b. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics and performance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers are acceptable:
1. Non-shrink grout:
 - a. BASF Corporation.
 - b. Euclid Chemical Company.
 - c. Five Star Products, Inc.
 - d. Sika Corporation.
 - e. Or equal.
 2. Epoxy grout:
 - a. BASF Corporation.
 - b. Five Star Products, Inc.
 - c. Euclid Chemical Company.
 - d. Sika Corporation.
 - e. Or equal.
 3. Synthetic fibers:
 - a. GCP Applied Technologies, Inc.
 - b. BASF Corporation.
 - c. Euclid Chemical Company.
 - d. Or equal.

2.2 MATERIALS

- A. Cement:
1. ASTM C150, Type II.
 2. ASTM C595, Type II.
 3. Cement type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- B. SCM:
1. Fly Ash:
 - a. ASTM C618, Class F or Class C.
 - b. Non-staining.
 - c. Suited to provide hardened concrete of uniform light gray color.
 - d. Compatible with other concrete ingredients and having no deleterious effects on the hardened concrete.
 - e. Produced by source approved by the Idaho Transportation Department for use in concrete for bridges.
 - f. Evaluate and use in accordance with ACI 232.2R.
 2. Cement and SCM type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- C. Admixtures:
1. Air entraining: ASTM C260.

2. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E, and provisions of ACI 212.3R.
 3. High range water reducers (superplasticizers): Conform to ASTM C494, Types F or G.
 4. All concrete mixes require the use of water reducers to maintain the specified water-to-cement ratios without additional cement.
 5. SCM: Per above.
 6. Admixtures to be chloride free.
 - a. Do not use calcium chloride.
 7. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.
 8. Provide admixtures certified by manufacturer to be compatible with other admixtures.
 9. Shrinkage reducing admixtures:
 - a. Admixture used to reduce the shrinkage of Portland Cement concrete.
 - b. Utilize at dosage necessary to help achieve required shrinkage value stated herein.
 - c. Similar to:
 - 1) Eclipse 4500 by GCP Applied Technologies, Inc.
 - 2) Conex by Euclid Chemical Co.
 - 3) MasterLife SRA 20 or MasterLife CRA 007 by BASF Corporation.
 - 4) Or equal.
- D. Macrosynthetic Fibers:
1. Conform to ASTM C1116.
 2. Dosage to obtain a minimum average residual strength at a net deflection of L/150: 170 PSI in accordance with ASTM C1609 and ASTM C1399.
 3. Acceptable manufacturers:
 - a. MasterFiber MAC Series by BASF Corporation.
 - b. Strux 90/40 by GCP Applied Technologies, Inc.
 - c. Tuf-Strand SF by Euclid Chemical Company.
 - d. Or equal.
 4. Use only where specifically indicated on the Drawings.
- E. Water:
1. Potable.
 2. Clean and free from deleterious substances.
 3. Free of oils, acids and organic matter.
- F. Aggregates for Normal Weight Concrete:
1. ASTM C33.
 2. Fine and coarse aggregates to be regarded as separate ingredients.
 3. Provide aggregates approved for bridge construction by the Department of Transportation of the State the project is located.
 4. Coarse aggregate:
 - a. Use only washed aggregates.
 - b. Coarse aggregate sieve analysis:
 - 1) Per Table 1 IN the PART 2 MIXES Article.
 5. Fine aggregates to be natural, not manufactured.
 6. Do not use aggregates that may be deleteriously reactive when combined with alkalis in cement.
 - a. Evaluate proposed aggregates for potential deleterious expansion due to alkali silica reactivity per ASTM C33 (Appendix X), ASTM C227, ASTM C1260, ASTM 1293, or ASTM C1567.
- G. Maximum total chloride ion content for concrete mix including all ingredients measured as a weight percent of cement in accordance with ASTM C1218:
1. Prestressed concrete: 0.06.
 2. All other concrete: 0.10.

- H. Non-shrink Grout:
 - 1. Non-shrink, nonmetallic, noncorrosive, and nonstaining.
 - a. Conform to ASTM C1107.
 - 2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
 - 3. Grout to produce a positive but controlled expansion.
 - a. Mass expansion shall not be created by gas liberation or by other means.
 - 4. Minimum 28 day compressive strength: 7,000 PSI.
 - 5. Acceptable manufacturers:
 - a. BASF Admixtures, Inc. "Masterflow, 713".
 - b. Euclid Chemical "NS Grout".
 - c. Sika Corporation "Sika Grout 212".
 - d. Or equal.
- I. Epoxy Grout:
 - 1. Three-component epoxy resin system:
 - a. Two liquid epoxy components.
 - b. One inert aggregate filler component.
 - 2. Adhesive acceptable manufacturers:
 - a. BASF "Masterflow 648".
 - b. Five Start Products, Inc. "DP Five Start Epoxy Grout."
 - c. Euclid Chemical "E3-G."
 - d. Sika "Sikadur Hi-Mod."
 - e. Or equal.
 - 3. Aggregate acceptable manufacturers:
 - a. BASF "Masterflow 648".
 - b. Five Start Products, Inc. "DP Five Start Epoxy Grout."
 - c. Euclid Chemical "Euclid aggregate."
 - d. Sika aggregate.
 - e. Or equal.
 - 4. Aggregate manufacturer shall be the same as the adhesive manufacturer.
 - 5. The aggregate shall be compatible with the adhesive.
 - 6. Each component furnished in separate package for mixing at jobsite.
- J. See Specification Section 03 31 31 for Grout Schedule of use.

2.3 MIXES

- A. General:
 - 1. Provide concrete capable of being placed without aggregate segregation and, when cured, of developing all properties specified.
 - 2. Ready-mixed concrete shall conform to ASTM C94/C94M.
 - 3. All concrete to be normal weight concrete, weighing approximately 145 to 150 LBS per cubic foot at 28 days after placement.
- B. Concrete Mixes: Refer to Table 1 below.
- C. Air Entrainment:
 - 1. Provide air entrainment in concrete resulting in a total air content percent by volume per Table 1 below.
 - a. Adjust dosage rate as necessary to compensate for shrinkage reducing admixtures.
- D. Slump:
 - 1. Measure slump at point of discharge into concrete members.
 - 2. Walls and columns:
 - a. 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.

- b. Slump shall be obtained by use of mid-range or high-range water reducer conforming to ASTM C494.
 - 3. All other members:
 - a. Concrete using a water reducer per ASTM C494: 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.
 - b. Concrete without a water reducer per ASTM C494: 5 IN maximum, 1 IN minimum measured at point of discharge into the concrete member.
 - 4. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
 - 5. Provide additional water or water reducing admixture at ready mix plant for concrete that is to be pumped to allow for slump loss due to pumping.
 - a. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified and the maximum specified water-cement ration is not exceeded.
 - 6. Slump may be adjusted in the field through the use of water reducers.
 - a. Coordinate dosage and mixing requirements with concrete supplier.
 - 7. Slump tolerances shall comply with the requirements of ACI 117.
- E. Proportioning:
 - 1. General:
 - a. Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placement and consolidation employed without permitting materials to segregate or excessive free water to collect on surface.
 - b. Proportion ingredients to produce proper placability, durability, strength and other required properties.
 - 2. Normal weight concrete target cementitious materials contents and maximum water cementitious ratios per Table 1 below.
 - a. Target cementitious materials contents are intended to provide a crack free, durable finished product, not one with excessive strength
 - 3. SCM:
 - a. Fly ash:
 - 1) For cast-in-place concrete only, a maximum of 25 PCT by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
 - 2) If fly ash is used, the water to fly ash plus cement ratio not to exceed the maximum water cement ratio specified in this Specification Section.
 - 3) Concrete containing fly ash shall not be used in the construction of the precast concrete units specified in Specification Section 03 41 33.
 - 4. Water reducing, retarding, and accelerating admixtures:
 - a. Use in accordance with manufacturer's instructions.
 - b. Add to mix at batching plant.
 - c. Use water-reducing or high-range water reducing admixture in concrete, as required, for placement and workability.
 - 1) Water reducers are required to maintain specified maximum water to cement ratios.
 - 5. High range water reducers (superplasticizers):
 - a. Use required for:
 - 1) All concrete to be pumped except slabs on grade.
 - 2) All concrete for water containing structures.
 - 3) Other concrete members at Contractor's option.
 - b. Maximum concrete slump before addition of admixture to be 3 IN maximum slump after addition to be 8 IN.
 - c. Reference Specification Section 03 31 31 for additional requirements.
 - 6. Macrosynthetic Fiber:
 - a. Dosage:

- 1) Determined by Contractor and concrete supplier as required to meet the specified minimum average residual strength.
- 2) Per ASTM C1399 and ASTM C1609.
- 3) Under no circumstances shall dosage be less than:
 - a) 4 LBS per cubic yard when used in concrete slabs on metal deck per SDI 31.
 - b) 3 LBS per cubic yard for all specified locations.
- b. Provide Macro Fiber in the following concrete members:
 - 1) Clarifier base slabs and walls.
- c. Uniformly disperse in concrete mixtures as indicated on Drawings.
- d. Use for concrete where indicated on Drawings.
7. Concrete mix proportioning methods for normal weight concrete:
 - a. Method 1:
 - 1) Used when combination of materials proposed is to be evaluated and proportions selected to be on a basis of trial mixes.
 - 2) Produce mixes having suitable proportions and consistencies based on ACI 211.1, using at least three different water cement ratios or cement contents which will produce a range of compressive strengths encompassing the required average strength.
 - 3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and for air entrained concrete, air content within 0.5 PCT specified.
 - 4) For each water cement ratio or cement content, make at least three trial strength tests for specified test age, and cure in accordance with ASTM C192.
 - a) Cylinder size: Per ASTM C31.
 - b) Test for strength at 28 days in accordance with ASTM C39.
 - (1) Quantity of cylinders per trial strength test:
 - (a) 6 IN DIA cylinders: Two.
 - (b) 4 IN DIA cylinders: Three.
 - 5) From results of these tests, plot a curve showing relationship between water cement ratio or cement content and compressive strength.
 - 6) From this curve select water cement ratio or cement content to be used to produce required average strength.
 - 7) Use cement content and mixture proportions such that maximum water cement ratio is not exceeded when slump is maximum specified.
 - 8) Base field control on maintenance of proper cement content, slump, air content and water cement ratio.
 - 9) See paragraph hereafter for definition of required average strength.
 - b. Method 2:
 - 1) In lieu of trial mixes, field test records for concrete made with similar ingredients may be used.
 - 2) Use of proposed concrete mix proportions based on field test records subject to approval by Engineer based on information contained in field test records and demonstrated ability to provide the required average strength.
 - 3) Field test records to represent materials, proportions and conditions similar to those specified.
 - a) Changes in the materials, proportions and conditions within the test records shall have not been more restricted than those for the proposed concrete mix.
 - b) Field test records shall meet the requirements of ACI 350, Paragraph 5.3.
 - 4) Required concrete proportions may be established by interpolation between the strengths and proportions of two or more test records each of which meets the requirements of this Specification Section.
8. Required average strength to exceed the specified 28 day compressive strength by the amount determined or calculated in accordance with ACI 318 or ACI 350, Chapter 5 using the standard deviation of the proposed concrete production facility as described in ACI 318 or ACI 350, Chapter 5.

- F. Flowable Fill or Controlled Low-Strength Material (CLSM):
1. A mixture of cement, fly ash, fine sand, water and air having a consistency which will flow under a very low head.
 2. Approximate quantities of each component per cubic yard of mixed material:
 - a. Cement (Type I or II; Type IL): 50 LBS.
 - b. Fly ash: 200 LBS.
 - c. Fine sand: 2,700 LBS.
 - d. Water (approximate): 420 LBS.
 - e. Air content (approximate): 10 PCT.
 3. Actual quantities shall be adjusted to provide a yield of 1 CUYD with the materials used.
 4. Approximate compressive strength should be 85 to 175 PSI.
 5. Fine sand shall be an evenly graded material having not less than 95 PCT passing the No. 4 sieve and not more than 5 PCT passing the No. 200 sieve.
- G. Allowable Shrinkage:
1. Per Table 1 when tested in accordance with ASTM C157 at 28 Days as modified within Specification Section 03 05 05.
 2. Continue testing to 64 weeks for informational purposes.

TYPE OF CONCRETE	28 DAY COMPRESSIVE STRENGTH	W/C RATIO	TARGET TOTAL CEMENT	SCM	ASTM C33 Size No.	AIR CONTENT	ALLOWABLE SHRINKAGE LIMIT
Normal weight concrete fill: utility encasement concrete	3000 PSI	0.45	517	Note 1	67	4-1/2 to 7-1/2	None
Normal weight precast concrete	5000 PSI	0.42	611		57	4-1/2 to 7-1/2	None
Normal weight all other concrete	4500 PSI	0.45	564	Note 1	57	4-1/2 to 7-1/2	0.048 PCT

Table 1 Notes:

1. If fly ash is proposed for use, the weight of fly ash plus weight of Portland cement shall be used to meet total target cement requirement.

2.4 SOURCE QUALITY CONTROL

- A. To assure stockpiles are not contaminated or materials are segregated, perform any test for determining conformance to requirements for cleanness and grading on samples secured from aggregates at point of batching.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Special Inspection:
1. See Specification Section 01 45 33.
 2. See Specification Section 03 05 05.
- B. Perform concrete tests per Specification Section 03 05 05.
1. Perform a strength test on all concrete to which water or superplasticizer, above the amount stated in the approved concrete mix design, has been added.
 - a. Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

END OF SECTION

SECTION 03 31 31
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mixing, placing, jointing, and curing of concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 45 33 – Special Inspections and Testing Program.
 - 4. Section 03 05 05 - Concrete Testing and Inspection.
 - 5. Section 03 11 13 - Formwork.
 - 6. Section 03 21 00 - Reinforcement.
 - 7. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 8. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
 - 9. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - d. 304.2R, Placing Concrete by Pumping Methods.
 - e. 305R, Guide to Hot Weather Concreting.
 - f. 305.1, Specification for Hot Weather Concreting.
 - g. 306R, Guide to Cold Weather Concreting.
 - h. 306.1, Standard Specification for Cold Weather Concreting.
 - i. 308.1, Specification for Curing Concrete.
 - j. 309R, Guide for Consolidation of Concrete.
 - k. 318, Building Code Requirements for Structural Concrete and Commentary.
 - l. 360R, Guide to Design of Slabs-on-Ground.
 - 2. ASTM International (ASTM):
 - a. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - c. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - d. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - e. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 3. Corps of Engineers (COE):
 - a. CRD-C572, Specifications for Polyvinylchloride Waterstop.
 - 4. National Ready Mixed Concrete Association (NRMCA):
 - a. Checklist for Certification of Ready Mixed Concrete Production Facilities.
- B. Qualifications:
 - 1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

2. Waterstop manufacturer's representative shall provide on-site training of waterstop installation, field splicing, welding and inspection procedures prior to construction, and at no additional cost to Owner.
- C. Pre-Concreting Conference:
1. A meeting to review the detailed requirements of the Contractor's proposed concrete design mixes, to determine the procedures for producing proper concrete construction, and to clarify the roles of the parties involved shall be held no later than 30 days after the Notice to Proceed.
 - a. Schedule the meeting to occur no later than five days in advance of the first scheduled date of concrete placement.
 2. All parties involved in the concrete work shall attend the conference, including:
 - a. Contractor's representative.
 - b. Testing laboratory representative/inspectors.
 - c. Concrete subcontractor.
 - d. Reinforcing steel installer.
 - e. Concrete supplier.
 - f. Owner.
 - g. Resident Engineer or Project Representative.
 - h. Design Engineer.
 - i. Building Code Official.
 3. The conference shall be held at a mutually agreed upon time and location.
 4. The agenda shall include but not be limited to the following:
 - a. Scheduling, sequence and notification of concrete placements.
 - b. Contractor's concrete pre-placement plan checklist.
 - c. Delivery time from batch plant, maximum time in truck, and approved exceptions to the limits.
 - d. Review of approved design mix including the limits of water that can be added and who is authorized to add water, if water has been withheld at the plant.
 - e. Additional test cylinders for structural elements the Contractor intends to subject to live loads earlier than 28 days.
 - f. Duties and authority of testing and inspection agency.
 - g. Curing procedures.
 - h. Temperature/weather issues.
 - i. Test cylinder storage and protection.
 - j. Approval and rejection of work.
 - k. Mock-up panels as the standard.

1.3 DEFINITIONS

- A. Words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 1) Procedure for adding high-range water reducer at the jobsite.
 - c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint profile dimensions for each joint type.
 - d. Manufacturers and types:
 - 1) Joint fillers.
 - 2) Curing agents.

- 3) Construction joint bonding adhesive.
 - 4) Pressure relief valves.
 - 3. Certifications:
 - a. Ready mix concrete plant certification.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Copies of concrete delivery tickets.
 - 3. Description of proposed curing methods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Delivery:
 - 1. Prepare a delivery ticket for each load of ready mixed concrete.
 - 2. Truck operator shall hand ticket to Contractor at the time of delivery.
 - 3. Ticket to show:
 - a. Mix identification.
 - b. Quantity delivered.
 - c. Amount of material in each batch.
 - d. Outdoor temperature in the shade.
 - e. Time at which cement was added.
 - f. Time of delivery.
 - g. Time of discharge.
 - h. Amount of water that may be added at the site without exceeding the specified water-cement ratio.
 - i. Amount of any approved water added at the site.

1.6 PROJECT CONDITIONS

- A. Adjust concrete mix design when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
 - 1. Do not use revised concrete mixes until submitted to and approved by Engineer.

1.7 SEQUENCING AND SCHEDULING

- A. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
 - 1. Approval of concrete mix design does not relieve Contractor of his responsibility to provide concrete that meets the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in this article are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 00.
- C. Neoprene Expansion Joint Fillers:
 - 1. Acceptable manufacturers:
 - a. Permaglaze.
 - b. Rubatex.
 - c. Williams Products.
 - d. Or equal.
 - 2. Materials:
 - a. Closed cell neoprene.
 - b. ASTM D1056, Type 2, Class A or C.

- c. Grade: Compression deflection as required to limit deflection to 25 PCT of joint thickness under pressure from concrete pour height.
- D. Asphalt Expansion Joint Fillers:
 - 1. Acceptable manufacturers:
 - a. W.R Meadows.
 - b. J and P Petroleum Products.
 - c. Or equal.
 - 2. Materials: ASTM D994.
- E. Fiber Expansion Joint Fillers:
 - 1. Materials: ASTM D1751.
- F. Evaporation Retarder:
 - 1. Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 2. Products:
 - a. BASF, Masterkure ER 50.
 - b. Euclid Chemical Company (The); Eucobar.
 - c. WR Meadows; EVAPRE.
 - d. Or equal.
- G. Curing Products to conform to one or more of the following:
 - 1. Absorbent Covers.
 - a. AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighting approximately 9 OZ/SQYD (305 G/SQM) when dry.
 - 1) These materials must be free of harmful substances, such as sugar or fertilizer, or substances that may discolor the concrete.
 - 2) To remove soluble substances, burlap should be thoroughly rinsed in water before placing it on the concrete.
 - 2. Moisture Retaining Covers.
 - a. Plastic Film: ASTM C171, 10 MIL minimum thickness polyethylene film.
 - b. White burlap-polyethylene sheet meeting ASTM C171.
 - c. Reinforced Curing Paper: Complying with ASTM C171.
 - d. Moisture Retaining Fabric.
 - 1) Conform to ASTM C171.
 - a) A naturally colored, non-woven polypropylene fabric with a 4 MIL non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light.
 - b) Fabric shall exhibit low permeability and high moisture retention.
 - c) Products:
 - (1) PNA Construction Technologies, Inc.; Hydracure M15.
 - (2) Reef Industries Incorporated; Transguard 4000.
 - 3. Dissipating curing compound:
 - a. Fugitive dye, waterborne, membrane-forming.
 - b. ASTM C309, Type 1D, Class A or B, shall be composed of hydrocarbon resins, and dissipating agents that begin to break down upon exposure to UV light, and traffic, approximately four to six weeks after applications, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions so as to not impair the later addition and performance of applied finishes.
 - c. Acceptable Products:
 - 1) Dayton Superior Corporation; Day Chem Rez Cure (J-11-WD).
 - 2) Euclid Chemical Company (The); Kurez DR VOX.
 - 3) L&M Construction Chemicals, Inc.; L&M Cure R.
 - 4) Or equal.
 - 4. Clear, water or solvent-borne, membrane-forming curing and sealing compound:
 - a. ASTM C1315, Type 1, Class A.
 - b. Moisture loss shall be not more than 0.40 KG/M² when applied at 300 SQFT/GAL.

- c. Manufacturer's certification is required.
- d. Subject to project requirements, provide one of the following products:
- e. Products:
 - 1) Euclid Chemical Company; Super Diamond Clear, Luster Seal 300 (exterior), Super Rez-Seal (interior).
 - 2) L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - 3) Meadows, W.R., Inc.; CS-309/30.
 - 4) Or equal.
 - 5) Euclid Chemical Company; Super Diamond Clear VOX.
 - 6) L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - 7) Meadows, W.R., Inc.; Vocomp-30.
 - 8) Or equal.

H. Bonding Agent:

- 1. Acceptable manufacturers:
 - a. L&M Construction Chemicals, Inc.
 - b. Sika.
 - c. Euclid Chemical Co.
 - d. Or equal.
- 2. Materials:
 - a. Latex: ASTM C1059, Type II.
 - b. Epoxy: ASTM C881, Type V.

I. Pressure Relief Valves:

- 1. Acceptable manufacturers:
 - a. Neenah Foundry, Model R-5000 Type C.
 - b. Waterman Industries, Model PRF-15.
 - c. Or equal.
- 2. Materials:
 - a. Cover: Bronze.
 - b. Body and strainer: Cast-iron.
 - c. Seal ring under cover: Neoprene.
- 3. Size:
 - a. Diameter: 4 IN.
 - b. Length: Sufficient length to penetrate the granular/ material at least 2 IN.

J. Screen for Pressure Relief Valve:

- 1. Material: Stainless steel, Type 304.
- 2. Wire gage: 16 GA minimum, 12 GA maximum.
- 3. Openings: 3/16 IN SQ.
- 4. Size: 12 by 12 IN minimum.

K. Non-shrink grout and epoxy grout: See Specification Section 03 31 30 for this non-structural material and use.

2.2 SOURCE QUALITY CONTROL

A. The concrete plant shall conform to the Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:

- 1. All materials and construction shall conform to the tolerances as specified in ACI 117.
- 2. Complete formwork.
 - a. See Specification Section 03 11 13.

3. Remove earth, snow, ice, water, and other extraneous/foreign materials from areas that will receive concrete.
 4. Secure reinforcement in place.
 - a. See Specification Section 03 21 00.
 5. Position expansion joint material, anchors and other embedded items.
 6. Obtain approval of formwork, reinforcement installation and placement prior to placing concrete.
 7. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and prior Engineer approval is obtained.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
 - b. Do not allow rainwater to increase mixing water nor to damage surface finish.
 8. Prepare all construction joints for proper bond per the Construction Joints - Bonding Paragraph in PART 3 of this Specification Section.
 9. Coat all construction joints with an approved bonding material, before new concrete is placed.
 - a. Apply proprietary bonding adhesive in accordance with manufacturer's instructions.
 10. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
 11. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains.
 - a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.
- B. Preparation of Subgrade for Slabs On Ground:
1. Subgrade to be wetted without standing water immediately prior to placing concrete.
 2. Obtain approval of subgrade compaction density prior to placing slabs on ground.
- C. Edge Forms and Screeds:
1. Set accurately to produce designated elevations and contours of finished surface.
 2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
 3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.2 CONCRETE MIXING

- A. General:
1. Provide all concrete from a central plant conforming to Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
 2. Batch, mix, and transport in accordance with ASTM C94/C94M.
- B. Control of Admixtures:
1. Control at the batch plant:
 - a. All admixtures to be introduced at the batch plant in accordance with manufacturer's recommendations.
 - b. Charge admixtures into mixer as solutions.
 - 1) Measure by means of an approved mechanical dispensing device.
 - 2) Liquid considered a part of mixing water.
 - 3) Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
 - c. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
 - d. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.

2. Control of Admixtures in the field:
 - a. Additional quantities of admixtures (with the exception of retarders) may be added in the field provided:
 - 1) Addition of admixtures shall be under the supervision of the ready mix quality control representative.
 - 2) Addition of each admixture to be documented on the delivery ticket.
 - 3) Provide additional mixing per ASTM C94.
- C. Tempering and Control of Mixing Water:
 1. Mix concrete only in quantities for immediate use.
 2. Discard concrete which has set.
 3. Discharge concrete from ready mix trucks within time limit stated in ASTM C94.
 4. Addition of water at the jobsite:
 - a. See Specification Section 03 31 30 for specified water cement ratio and slump.
 - b. Do not exceed maximum specified water cement ratio or slump.
 - c. Incorporate water by additional mixing equal to at least half of total mixing required.

3.3 PLACING OF CONCRETE

- A. General:
 1. Place concrete as such a rate that concrete, which is being integrated with fresh concrete, is still workable.
 - a. Select placement equipment and manpower in order to assure timely delivery of concrete into forms to avoid unintended cold joints and placement consolidation issues.
 2. Comply with ACI 304R and ACI 304.2R.
 3. Do not begin placing concrete during rain, sleet, or snow.
 - a. Protect fresh concrete from ensuing inclement weather.
 4. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
 5. Begin work only when work of other trades affecting concrete is complete.
 6. Do not use excess grout or mortar to lubricate lines when pumping concrete.
 7. Do not use excess water for workability or any reason when placing concrete by freefall.
 8. Deposit concrete continuously to avoid cold joints.
 9. Locate construction joints at locations specified or approved by Engineer.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
 10. Spreaders:
 - a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
 - b. Embedded:
 - 1) Obtain approval of Engineer for their use.
 - 2) Materials: Concrete or metal.
 - 3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
 11. Deposit concrete as nearly as practicable in its final position to avoid segregation.
 - a. Maximum free fall: 4 FT.
 - b. Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 FT of surface.
 12. Perform the following operations before bleeding water has an opportunity to collect on surface:
 - a. Spread.
 - b. Consolidate.
 - c. Straightedge.
 - d. Darby or bull float.
 13. No water shall be added to the concrete surface to ease finishing operation.
 14. Do not discharge water into forms.
 15. Consider use of form vibrators for certain placement situations.
- B. Cold Weather Concrete Placement:

1. Comply with ACI 306.1.
 2. Do not place concrete on forms or subgrades that are below 32 DEGF or contain frozen material.
 3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
 4. Temperature of concrete when discharged at site: Per ACI 306.1.
 5. Heat subgrade forms, embedments and reinforcement to between 45 and 70 DEGF, when temperature of surrounding air is 40 DEGF or below at time concrete is placed.
 - a. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
 6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 DEGF.
 7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 DEGF.
 8. Follow ACI 306R for specific requirements dealing with elevated steel troweled slabs that will be exposed to freeze-thaw cycles.
- C. Hot Weather Concrete Placement:
1. Comply with ACI 305.1.
 2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
 3. Temperature of concrete at point of delivery (i.e. truck discharge) when placed:
 - a. Not to exceed 90 DEGF.
 - b. Not so high as to cause:
 - 1) Shrinkage cracks.
 - 2) Difficulty in placement due to loss of slump.
 - 3) Flash set.
 4. Temperature of forms and reinforcing when placing concrete:
 - a. Not to exceed 90 DEGF.
 - b. May be reduced by spraying with water to cool below 90 DEGF.
 - 1) Leave no standing water to contact concrete being placed.
 5. Prevent plastic shrinkage cracking and/or slab curling due to evaporation.
- D. Consolidating:
1. Consolidate in accordance with ACI 309R except as modified herein.
 2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
 - a. Ensure no displacement of reinforcing or other embeds from final position.
 - b. Eliminate:
 - 1) Air or stone pockets.
 - 2) Honeycombing or pitting.
 - 3) Planes of weakness.
 3. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
 - a. Size and coordinate external vibrators to specifically match forming system used.
 4. Internal vibrators:
 - a. Minimum frequency of 8000 vibrations per minute.
 - b. Insert and withdraw at points approximately 18 IN apart.
 - 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
 - c. Use in:
 - 1) Beams and girders of framed slabs.
 - 2) Columns and walls.
 - 3) Vibrating concrete around all waterstops.
 - d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.

5. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other approved means.
 6. Do not use vibrators to transport concrete within forms.
 7. When placing self-consolidating concrete, the use of form or pencil vibrators is acceptable, provided such methods do not cause aggregate segregation, or otherwise adversely affect the quality of the work.
 8. Provide sufficient spare vibrators on jobsite during all concrete placing operations to assure continuous vibration.
 9. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
 10. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- E. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.
 2. Horizontal belt conveyors:
 - a. Mount at a slope which will not cause segregation or loss of ingredients.
 - b. Protect concrete against undue drying or rise in temperature.
 - c. Use an arrangement at discharge end to prevent segregation.
 - d. Do not allow mortar to adhere to return length of belt.
 - e. Discharge conveyor runs into equipment specially designed for spreading concrete.
 3. Metal or metal lined chutes:
 - a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
 - b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
 - c. Provide end of each chute with a device to prevent segregation.
 4. Pumping or pneumatic conveying equipment:
 - a. Designed for concrete application and having adequate pumping capacity.
 - b. Control pneumatic placement so segregation is avoided in discharged concrete.
 - c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
 - d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
 - e. Provide pumping equipment without Y sections.

3.4 JOINTS AND EMBEDDED ITEMS

- A. Construction Joints - General:
1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
 - a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Specification Section.
 2. Unplanned construction joints will not be allowed.
 - a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
 3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
 4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
 - a. At Contractor's option, beam pockets may be formed into concrete walls.
 - b. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.
 5. Place beams, girders, column capitals and drop panels at same time as slabs.

6. Place corbels monolithically with their supporting members.
 - a. Locate wall vertical construction joints midway between corbels.
 - b. Where only a single corbel is located, place it also monolithically with wall and locate wall vertical construction joint a minimum of 3 FT from face of corbel.
 7. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
 8. Provide the following joints unless noted otherwise on Drawings:
 - a. Roughen joints: horizontal construction joints.
 - b. Keyed joints: vertical construction joints.
 9. Roughen construction joints:
 - a. Clean the previously hardened concrete interface and remove all laitance.
 - b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
 10. Keyways:
 - a. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings or as directed by Engineer.
 - b. Wall keys:
 - 1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
 - 2) Keyway depth to be not less than 1-1/2 IN.
 - 3) Continuous along length of wall.
 - 4) Place keyway in wall center unless shown otherwise on Drawings.
 - c. Keyways in footings, foundations, base slabs, and structural or elevated slabs:
 - 1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
 - 2) Keyway depth not less than 1-1/2 IN.
 - 3) Continuous along footing or slab.
 - 4) Keyway in footing or slab center unless shown otherwise on Drawings.
 - d. Beam keyways:
 - 1) Full width of beam.
 - 2) Keyway height not less than 5-1/2 IN.
 - 3) Keyway depth not less than 1-1/2 IN.
 - 4) Keyway located in initial beam pour, directly above the bottom reinforcing, unless shown otherwise on Drawings.
 11. Minimum time before placement of adjoining concrete construction:
 - a. All concrete: 60 HRS, unless otherwise noted.
- B. Construction Joints - Spacing Unless Otherwise Specified:**
1. Structures not intended to contain liquid:
 - a. Wall vertical construction joints:
 - 1) 50FT maximum centers.
 - 2) At wall intersections, 4FT minimum from corner.
 - b. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square and not to exceed 4000 SQFT.
 - 2) Maximum side dimension of a slab pour to be 70FT.
 2. Water retaining structures:
 - a. Wall vertical construction joints:
 - 1) 30 FT maximum centers.
 - 2) At wall intersections, 10 FT minimum from corner.
 - b. Wall horizontal construction joints: 18 FT centers.
 - c. Walls that are thicker than 18 IN may be poured up to 30 FT tall in one pour provided the following requirements are satisfied:
 - 1) A test wall of similar size, height and thickness will be poured to demonstrate the quality of the concrete work.
 - 2) The test wall will be located as a portion of a non-water retaining wall.
 - a) The test wall will include a waterstop at the bottom of the wall.

- b) Alternatively, a separate test wall, not part of the final work, may be constructed.
 - 3) The concrete placement and concrete quality of the test wall will be observed by the Engineer.
 - a) Concrete will be judged on the following:
 - (1) Ability to keep bottom of the pour clean and free from trash and debris.
 - (2) Ability to protect the waterstop from folding over due to the force of falling concrete.
 - (3) Ability to properly consolidate all concrete in the wall pour, including below formed openings.
 - 4) Engineer will evaluate the Contractor's work and may recommend taller concrete wall pours if concrete quality is acceptable.
 - 5) Preparation for all subsequent wall pours over 18 FT tall must be the same as the preparation of the test wall.
 - 6) Should the quality of concrete work on subsequent wall pours be judged inadequate, when compared to the original accepted test wall, the Contractor may be directed to limit wall pour heights to 18 FT as originally specified.
 - 7) Should the quality of concrete work on the test wall be judged inadequate, additional test walls will not be observed and judged to allow pour heights greater than 18 FT unless approved by Engineer.
 - d. Floor slab, construction joints:
 - 1) Placements to be approximately square and not to exceed 2000SQFT.
 - 2) Maximum side dimension of a slab pour to be less than:
 - a) Twice the length of the short side.
 - b) 60FT.
 - e. Elevated slab construction joints:
 - 1) Placements to be approximately square and not to exceed 4000SQFT.
 - 2) Maximum side dimension of a slab pour to be less than:
 - a) Twice the length of the short side.
 - b) 70FT.
- C. Construction Joints - Bonding:
- 1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.
 - 2. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened, as outlined below:
 - 3. Roughen construction joints:
 - a. Roughen the surface of the concrete to expose the coarse aggregate uniformly with 1/4 IN minimum amplitude.
 - 1) Remove laitance, loosened particles of aggregate or damaged concrete at the surface.
 - 4. Keyed construction joints:
 - a. Thoroughly clean construction joints and remove all laitance.
 - b. Dampen the hardened concrete immediately prior to placing of fresh concrete.
- D. Slab On Grade Joints:
- 1. Locate construction and control joints in slabs on grade as indicated on Drawings.
 - 2. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
 - a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
 - b. Complete before shrinkage stresses become sufficient to produce cracking.
- E. Expansion Joints:
- 1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.

2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
 3. Seal expansion joints as shown on Drawings.
 - a. See Specification Section 07 92 00 for requirements.
- F. Pressure Relief Valves and Screens:
1. Provide and install 4 IN ID pressure relief valves in locations shown on the Drawings.
 2. Place valves in true vertical position (90 DEG from the true horizontal plane).
 3. Place screens immediately upon granular material and under pressure relief valves as shown on Contract Drawings.
 - a. Leave no space between valves, screen, and granular material.
- G. Other Embedded Items:
1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
 - a. Give Contractor whose work is related or integral to concrete, or supported by it, ample notice and opportunity to furnish and install items before placing concrete.
 2. Do not route electrical conduit, drains, or pipes in concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.
- H. Placing Embedded Items:
1. Support against displacement.
 2. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
 3. Provide adequate means for anchoring waterstop in concrete.
 - a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

3.5 FINISHING

- A. See Specification Section 03 35 00.
- B. Coordinate mixing and placing with finishing.

3.6 INSTALLATION OF GROUT

- A. Grout Schedule:
 1. Non-shrinking non-metallic grout:
 - a. Filling form tie holes.
 - b. Under column and beam base plates.
 - c. Other uses indicated on the Drawings.
 2. Epoxy grout:
 - a. Patching cavities in concrete.
 - b. Grouting of dowels and anchor bolts into existing concrete.
 - c. Grouting of rotating or oscillating equipment base plates where driving motor is 500 HP and above.
 - d. As noted on the Drawings.
- B. Grout Installation:
 1. Non-shrink non-metallic grout:
 - a. Clean concrete surface to receive grout.
 - b. Saturate concrete with water for 24 HRS prior to grouting.
 - c. Mix in a mechanical mixer.
 - d. Use no more water than necessary to produce flowable grout.
 - e. Place in accordance with manufacturer's instructions.
 - f. Provide under beam, column, and equipment base plates, in joints between precast concrete and cast slabs, and in other locations indicated on the Drawings.
 - g. Completely fill all spaces and cavities below the top of base plates.
 - h. Provide forms where base plates and bed plates do not confine grout.
 - i. Where exposed to view, finish grout edges smooth.

- j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate, bed plate, member or piece of equipment.
 - k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
2. Epoxy grout:
- a. Mix and place in accordance with manufacturer's instructions.
 - b. Apply only to clean, dry, sound surface.
 - c. Completely fill all cavities and spaces around dowels and anchors without voids.
 - d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
 - e. Obtain manufacturer's field technical assistance as required to assure proper placement.

3.7 CURING AND PROTECTION

- A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
- 1. Follow recommendations of ACI 308.1 except as modified herein.
 - 2. All traffic shall be kept from the surface as necessary to protect the concrete but not less than the first 48 HRS of curing.
 - 3. Evaporation retarder:
 - a. Apply evaporation retarder to uniformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 LB/SQFT x HR (1 KG/SQM x HR) before and during finishing operations.
 - 1) Apply according to manufacturer's written instructions one or more times after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- B. For surfaces of non-water bearing structures, apply one of the following curing procedures immediately after completion of placement and finishing (surfaces not in contact with forms).
- 1. Ponding or continuous sprinkling. Take care to avoid eroding the surface of freshly placed concrete.
 - 2. Application of wet Absorbent Covers:
 - a. Minimum lap: 12 IN.
 - b. Provide continuous uniform supply of moisture, such as sprinklers or soaker hoses as required to keep concrete surface continuously wet.
 - c. Monitor Absorbent Covers as required to prevent cover materials or concrete surface from drying out.
 - 3. Continuous application of steam (not exceeding 150 DEGF) or mist spray.
 - 4. Application of Moisture Retaining Cover sheet materials.
 - a. Place as soon as possible after final finishing and without marring the surface.
 - b. Minimum lap: 12 IN.
 - c. Seal all edges to make water-tight.
 - d. Place Moisture Retaining Cover in intimate contact with the concrete surface, without wrinkles and weighted to hold in place.
 - e. Hold cover and edges in place as required to prevent wind from displacing the cover.
 - f. Moisture Retaining Fabric:
 - 1) Install in accordance with manufacturer's written recommendations.
 - 2) Saturate concrete surface and fabric side of cover immediately prior to placing.
 - g. Monitor continuously during the curing period:
 - 1) Repair any holes, tears or displaced cover.
 - 2) Rewet as required to keep concrete moist under cover.
 - 5. Application of other moisture retaining covering as approved by Engineer.
 - 6. Water used for curing shall be within 20 DEGF of the concrete temperature.
 - 7. Application of a curing compound.

- a. Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen, which may develop after finishing, has disappeared from concrete surface.
 - b. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
 - c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two coats of the curing compound.
 - 1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
 - 2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
 - 3) Allow the preceding coat to completely dry prior to applying the next coat.
 - 4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
8. Surfaces In Contact with Forms:
- a. Formed surfaces: Cure formed concrete surfaces utilizing final curing methods per ACI 308.1, including underside of beams, supported slabs, and other similar surfaces,
 - 1) See Section 03 11 13.
 - b. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
 - c. Make provisions to keep concrete wall moist while stripping forms and until curing measures are in place.
 - d. After form removal, cure concrete until end of time prescribed.
 - e. Use one of the methods listed above.
 - f. Forms left in place shall not be used as a method of curing in hot weather.
 - g. The term "hot weather", where used in these specifications, is defined in ACI 305.1.
 - h. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.
- C. For Surfaces of Water Bearing Structures:
- 1. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
 - a. Follow recommendations of ACI 308.1 except as modified herein.
 - b. Use Evaporation Retardant to reduce surface moisture evaporation of slabs during concrete placement. Comply with all the manufacturer's instructions of use as required to obtain the intended results.
 - 2. Apply one of the following moist curing procedures immediately after completion of placement and finishing, for concrete surfaces not in contact with forms.
 - a. Ponding or continuous sprinkling.
 - b. Application of absorptive mats or fabric kept continuously wet and in intimate contact with concrete.
 - c. Surfaces shall be covered with a double layer of absorptive mats or fabric, wetted before placing, and overlapped at least 6 IN.
 - d. Application of sand kept continuously wet.
 - e. Continuous application of steam (not exceeding 150 DEGF) or mist spray.
 - f. Ponding and sprinkling in conjunction with application of waterproof sheet materials, conforming to ASTM C171 and only with a program as approved by the Engineer that will keep the surface continuously wet.
 - g. Ponding and sprinkling in conjunction with application of other moisture retaining covering as approved and only with a program as approved by the Engineer that will keep the surface continuously wet.
 - 3. After seven full days of moist curing, application of a curing compound conforming to ASTM C309 may be substituted for moist curing.

- 1) Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen which may develop during moist curing has disappeared from concrete surface.
 - 2) Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
 - 3) Where a surface is cured with a curing compound, the surface shall be covered with a minimum of two coats of the curing compound, 30 MILS thick each coat.
 - a) Apply the first coat of curing compound immediately after form removal or discontinued moist curing and before the surface displays water loss. Apply in one direction only, covering uniformly to a minimum thickness of 30 MILS.
 - b) The concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
 - c) Allow the preceding coat to completely dry prior to applying the next coat.
 - d) Apply second coat in direction perpendicular to the first coat application direction, covering uniformly to a minimum thickness of 30 MILS.
 - 4) Curing compounds used in water treatment plant construction shall be non-toxic and taste and odor free and be NSF approved.
 - a) Alternately, all tank surfaces shall be cleaned to remove non-NSF approved curing compound without damaging the concrete finish.
4. Curing Concrete In Contact with Forms:
- a. Minimize moisture loss of concrete placed in forms by keeping forms wet and cool until they can be safely removed.
 - b. Moist cure the top surface of concrete placed in forms as specified.
 - c. After form removal, cure concrete until end of time prescribed.
 - 1) Use one of methods listed above.
 - 2) When approved by the Engineer, placement of the second pour at joints may occur prior to the end of the curing period.
 - d. Forms left in place shall not be used as a method of curing in hot weather.
 - e. The term "hot weather", where used in these specifications, is defined in ACI 305R.
 - f. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete and commence moist curing as specified.
- D. Curing Period:
1. Continue curing for at least 14 days for all water bearing concrete except high early strength concrete for which period shall be at least three days.
 2. Continue curing for at least seven days for all concrete except Type III, high early strength concrete for which period shall be at least three days.
 - a. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is two days old, provided concrete is not permitted to become surface dry during transition.
- E. Cold Weather:
1. Follow recommendations of ACI 306.1.
 2. Maintain temperature of concrete per ACI 306.1 for a minimum of 72 HRs after concrete is placed, when outdoor temperature is 40 DEGF, or less.
 - a. Maximum temperature rate of decrease: Per ACI 306.1.
 3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
 4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
 5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.
- F. Hot Weather:
1. Follow recommendations of ACI 305.1 and ACI 308.1.

2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
 3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.
 4. Maximum temperature rate of decrease: Per ACI 305.1.
- G. Rate of Temperature Change:
1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.
- H. Protection from Mechanical Injury:
1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
 2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
 3. Do not load self-supporting structures in such a way as to overstress concrete.

3.8 FIELD QUALITY CONTROL

- A. Special Inspections per Building Code:
1. See Section 01 45 33 and 03 05 05.
 2. Special Inspection is required for:
 - a. Concrete tests per Specification Section 03 05 05.
 - b. Verification of proper mix design.
 - 1) Frequency: Periodically, prior to each concrete pour.
 - c. Proper reinforcing installation per Specification Section 03 21 00 and Drawings.
 - d. Proper concrete placement techniques.
 - 1) Inspect per requirements of this Section.
 - 2) Inspect mass concrete per approved thermal monitoring plan.
 - 3) Frequency: During each concrete pour.
 - e. Proper curing temperature and techniques.
 - 1) Inspect per requirements of this Section.
 - 2) Frequency: Periodically, but not less than every third day.
 - f. Cast-in-place anchors: Per Section 03 15 19.
- B. Inspections, Non-Code Required.
1. Joints:
 - a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
 - b. Frequency: Prior to each concrete pour.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete finishing and repair of surface defects.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 11 13 - Formwork.
 - 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - 2. ASTM International (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - c. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - d. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - e. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - f. D4259, Standard Practice for Abrading Concrete.
 - 3. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 13/NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
 - 1. Applicator of acrylic, epoxy, and surfacer/filler must be approved, in writing, by manufacturer.
 - 2. Manufacturer of acrylic, epoxy, and surfacer/filler shall have minimum of five (5) years experience in manufacturing of same with documented performance history for similar installations.
 - 3. Installer/applicator of acrylic, epoxy, and surfacer/filler shall have minimum of three (3) years experience installing similar coatings and shall be licensed or approved in writing by manufacturer to install/apply this product.
 - 4. Applicator of concrete sealers shall be factory trained and approved, in writing, by the manufacturer to apply the product.
 - a. Applicator shall have a minimum of five (10) years experience successfully applying materials specified. Provide references for minimum of three (3) different projects completed in the last five (5) years with similar scope of work.
 - 1) Include name and address of project, size of project in value (product application) and contact person.

1.3 DEFINITIONS

- A. Vertical Surface Defects:
 - 1. Any void in the face of the concrete deeper than 1/8 IN, such as:
 - a. Tie holes.
 - b. Air pockets (bug holes).

- c. Honeycombs.
 - d. Rock holes.
 - 2. Scabbing:
 - a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
 - 3. Foreign material embedded in face of concrete.
 - 4. Fins 1/16 IN or more in height.
- B. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- C. Other words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Certifications:
 - a. Certification of aggregate gradation.
 - b. Certification that products being used will not interfere with bonding of future floor or wall finishes.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations and requirements for materials used.

1.6 WARRANTY

- A. Provide warranty equal to specified manufacturer's standard warranty for all products used.

1.7 PROJECT CONDITIONS

- A. Environmental limitations:
 - 1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance of concrete floor sealers and hardeners.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical floor sealer (CS-1) (CS-3):
 - a. L&M Construction Chemicals, Inc.
 - b. Euclid Chemical Co.
 - c. Dayton Superior.
 - d. Or equal.
 - 2. Bonding agents:
 - a. Euclid Chemical Co.
 - b. BASF Admixtures, Inc.

- c. L&M Construction Chemicals, Inc.
- d. Or equal.
- 3. Epoxy Bonding Adhesive:
 - a. Sika Corporation.
 - b. Euclid Chemical Company.
 - c. Or equal.
- 4. Anti-Corrosion Bonding Agent:
 - a. Sika Corporation.
 - b. Euclid Chemical Company.
 - c. BASF Building Systems.
 - d. Or equal.

2.2 MATERIALS

- A. Chemical Floor Sealer CS-1:
 - 1. Colorless low VOC water-based solution containing acrylic copolymers.
 - a. ASTM C1315, Class B, minimum 30 percent solids.
 - b. ASTM C309, Type 1.
 - c. Non-yellowing UV resistant.
 - d. Capable of being painted after cured.
 - 2. L&M Construction Chemicals, Inc. Dress and Seal WB 30.
- B. Bonding Agent:
 - 1. All bonding agents and adhesives shall have a pot life that allows proper placement of new material against existing material as prescribed by manufacturer.
 - 2. For repair of surface defects when no reinforcement is exposed, and where specifically noted on the Drawings, use Epoxy Bonding Adhesive.
 - 3. For repair of surface defects when reinforcement is exposed, and where specifically noted on the Drawings, use Anti-Corrosion Bonding Agent.
 - 4. For general use surface defect repairs, unless otherwise noted or specified, use:
 - a. At concrete surfaces not receiving liquid water repellent coating:
 - 1) High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
 - a) Euclid Chemical Co. "Flex-Con."
 - b) BASF Admixtures, Inc. "Acryl-Set."
 - c) L&M Construction Chemicals, Inc. "Everbond."
 - d) Thoro System Products "Acryl 60."
 - b. At concrete surfaces receiving liquid water repellent:
 - 1) Non-acrylic base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
- C. Cement:
 - 1. ASTM C150, Type II Portland for areas exposed to sewage.
 - 2. ASTM C150, Type I Portland elsewhere.
- D. Aggregate:
 - 1. Sand: Maximum size #30 mesh sieve.
 - 2. For exposed aggregate finish surfaces: Same as surrounding wall.
- E. Water: Potable.
- F. Nonshrink Grout: See Specification Section 03 31 30 and Specification Section 03 31 31.
- G. Epoxy Patch Seal:
 - 1. For use as seal on water-bearing form-tie holes, and as otherwise specified.
 - a. Sikadur 32 Hi-Mod LPL by Sika Corporation.
 - b. Approved equivalent.
- H. Epoxy Bonding Adhesive:

1. For use where bonding new concrete to existing concrete.
 2. Two component, moisture insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.
 - a. Sikadur 32 Hi-Mod LPL by Sika Corporation.
 - b. Euco No. 452 MV by Euclid Chemical Company.
 - c. Or equal.
- I. Cementitious Polymer Modified Patch:
1. Two component polymer-modified Portland cement non-sag mortar for patching vertical and overhead concrete surfaces.
 - a. SikaTop 123 Plus by Sika Corporation.
 - b. Verticoat by Euclid Chemical Company.
 - c. Or equal.
- J. Anti-Corrosion Bonding Agent:
1. Three component, moisture tolerant, cementitious bonding agent manufactured for the purpose of bonding fresh concrete to hardened concrete and providing an anti-corrosion coating to the embedded reinforcing.
 - a. Sika Armatec 110 EpoCem by Sika Corporation.
 - b. Duralprep A.C. by Euclid Chemical Company.
 - c. Emaco P24 by BASF Building Systems.
 - d. Or equal.

2.3 MIXES

- A. Bonding Grout: One (1) part cement to one (1) part aggregate.
- B. Patching Mortar:
1. One (1) part cement to two and one-half (2-1/2) parts aggregate by damp loose volume.
 - a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. For repair of surface defects and other damage at existing concrete structures, see Specification Section 03 01 37.
- B. For repair of cracks in concrete, see Specification Section 03 01 38.
- C. For methods of curing, see Specification Section 03 31 31.
- D. Preparation of Bonding Grout Mixture:
1. Mix cement and aggregate.
 2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
 3. Add bonding agent/water mixture to cement/aggregate mixture.
 4. Mix to consistency of thick cream.
 5. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.
- E. Preparation of Patching Mortar Mixture:
1. Mix cement and aggregate.
 2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
 3. Add only enough bonding agent/water mixture to cement/aggregate mixture to allow handling and placing.
 4. Let stand with frequent manipulation with a trowel, until mix has reached stiffest consistency to allow placement.

- F. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
 - 1. Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
 - 2. Chip concrete substrate to obtain a surface profile of 1/16 IN to 1/8 IN in depth with new fractured aggregate surface. The area to be repaired shall not be less than 1/2 IN in depth.
 - a. Make edges perpendicular to surface or slightly undercut.
 - b. No feathered edges will be permitted
 - 3. Concrete removal shall extend along any exposed reinforcement to locations along the bar that are free of bond inhibiting corrosion and where the bar is well bonded to surrounding concrete.
 - 4. Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.

- G. Repairing Surface Defects at Surfaces Not in Contact With Liquid:
 - 1. This method of repairing surface defects is to be used at new concrete construction only on vertical concrete surfaces, above finished grade, only on exterior surfaces of Water-Bearing structures unless surface is below finished grade, and on surfaces to receive liquid water repellent.
 - 2. At small surface defects less than four (4) square IN at surface and shallower than 1/2 IN:
 - a. Use Patching Mortar mix.
 - b. Use Bonding Grout.
 - c. Match color of surrounding wall.
 - d. Do not use acrylic bonding agent in patching mortar for filling defects in surfaces to be treated with liquid water repellent.
 - 3. At surface defects larger than four (4) square IN at surface and deeper than 1/2 IN:
 - a. Use Nonshrink grout.
 - b. Use Epoxy Bonding Adhesive.
 - c. Cut perimeter of patch to 1/4 IN minimum depth at entire perimeter, with edge perpendicular to the surface to eliminate feathered edges.
 - d. If applicable, gouge void to eliminate thin patch areas less than 1/2 IN deep that are surrounded by deeper patch areas.
 - e. Patch may gradually taper from maximum depth to a minimum of 1/4 IN depth at the perimeter
 - f. When reinforcement is exposed, gouge void at exposed reinforcement to a depth of 1/2 IN beyond the reinforcement to allow patch material to lock around reinforcement.
 - g. Where exposed to view and scheduled to receive concrete Finish #2 or #5, hold grout 1/4 IN below surface of concrete and fill with patching mortar to match surrounding concrete.
 - 4. At tie holes:
 - a. Use Nonshrink grout.
 - b. Where exposed to view and scheduled to receive concrete Finish #2 or #5, hold grout 1/4 IN below surface of concrete and fill with patching mortar to match surrounding concrete.
 - 5. If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution followed by a thorough rinse with clean water.
 - a. Test concrete to determine pH level and continue flushing with clean water until surface pH is within acceptable limits.
 - 6. Dampen area to be patched and an area at least 6 IN wide surrounding it prior to application of bonding grout.
 - 7. Brush bonding grout into the surface after the surface water has evaporated.
 - 8. Allow bonding grout to set for period of time required by bonding agent manufacturer before applying premixed patching mortar.
 - 9. Consolidate grout or mortar into place and strike off so as to leave patch slightly higher than surrounding surface.

10. Leave undisturbed for at least 60 minutes before finishing level with surrounding surface.
 - a. Do not use metal tools in finishing a patch in a formed wall which will be exposed or coated with other materials.
 11. Keep areas damp in accordance with grout manufacturer or bonding agent manufacturer's directions.
- H. Repairing Surface Defects at Surfaces in Contact With Liquid:
1. This method of repairing surface defects is to be used at new concrete construction on exterior vertical concrete surfaces below finished grade and on all surfaces in direct contact with liquid at Water-Bearing structures.
 2. At small surface defects less than four (4) square IN at surface and less than 1/2 IN in depth:
 - a. Use Cementitious Polymer Modified Patch.
 - b. Use Epoxy Bonding Adhesive.
 - c. Apply seal coat of Epoxy Adhesive over the patched area, on the face in contact with liquid within 72 HRS of patching and after initial curing of patch material. Extend the seal coat to one (1) IN beyond the patch on all sides.
 3. At tie holes:
 - a. Use Nonshrink grout.
 - b. Use Epoxy Bonding Adhesive.
 - c. Apply seal coat of Epoxy Adhesive over the tie hole patch, on the face in contact with liquid within 72 HRS of patching and after initial curing of nonshrink grout. Extend the seal coat to one (1) IN beyond the tie hole patch on all sides.
 4. At surface defects larger than four (4) square IN at surface and deeper than 1/2 IN when no reinforcement is exposed:
 - a. Use Cementitious Polymer Modified Patch.
 - b. Use Epoxy Bonding Adhesive.
 - c. Cut perimeter of patch to 1/4 IN minimum depth at entire perimeter, with edge perpendicular to the surface to eliminate feathered edges.
 - d. If applicable, gouge void to eliminate thin patch areas less than 1/2 IN deep that are surrounded by deeper patch areas.
 - e. Patch may gradually taper from maximum depth to a minimum of 1/4 IN depth at the perimeter.
 - f. Apply seal coat of Epoxy Adhesive over the patched area, on the face in contact with liquid within 72 HRS of patching and after initial curing of patch material. Extend the seal coat to one (1) IN beyond the patch on all sides.
 5. At surface defects larger than four (4) square IN at surface and deeper than 1/2 IN when reinforcement is exposed:
 - a. Use Cementitious Polymer Modified Patch.
 - b. Use Anti-Corrosion Bonding Agent.
 - c. Cut perimeter of patch to 1/4 IN minimum depth at entire perimeter, with edge perpendicular to the surface to eliminate feathered edges.
 - d. If applicable, gouge void to eliminate thin patch areas less than 1/2 IN deep that are surrounded by deeper patch areas.
 - e. Patch may gradually taper from maximum depth to a minimum of 1/4 IN depth at the perimeter.
 - f. Gouge void at exposed reinforcement to a depth of 1/2 IN beyond the reinforcement to allow patch material to lock around reinforcement.
 - 1) Abrasive blast exposed reinforcement to remove contaminants and rust to achieve a white-metal finish.
 - 2) Contact Engineer if section loss in reinforcement is greater than 15 percent.
 - g. Apply seal coat of Epoxy Adhesive over the patched area, on the face in contact with liquid within 72 HRS of patching and after initial curing of patch material. Extend the seal coat to one (1) IN beyond the patch on all sides.
- I. For all repairs of surface defects at new concrete construction, the finish of the repaired areas shall match the required finish for the concrete surface being repaired.

1. See ARTICLE 3.2 for required finishes.
- J. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 DegF.
 1. If necessary, enclose and heat area to between 50 and 70 DegF during repair of surface defects and curing of patching material.
 - a. Use only clean fuel, indirect fired heating apparatus.
- K. Chemical Floor Sealer Application:
 1. General:
 - a. Immediately prior to Substantial Completion, thoroughly clean floor in accordance with ASTM D4258 and prepare to receive chemical floor sealer.
 - 1) Remove previously applied membrane curing compounds.
 - 2) Remove soil, oils, stains, discoloration, or any other imperfection having a negative impact on the appearance of the finished floor.
 - b. Apply product to floor areas indicated on the Drawings.
 - c. Apply in accordance with manufacturer's published installation instructions.
 2. Chemical Floor Sealer (CS-1):
 - a. Apply two (2) uniform coats at rate recommended by manufacturer.
 - 1) Apply using manufacturer's recommended equipment with a fan-tip nozzle.
 - 2) Do not allow material to puddle.
 - b. Allow first coat to completely dry before applying second coat.
 - c. Spotted or mottled appearances will not be accepted.
 3. Chemical Floor Sealer, Hardener, Densifier (CS-2):
 - a. Apply two (2) uniform coats at rate recommended by manufacturer.
 - 1) Scrub the material into the floor, keeping the material wet. After material has gelled, keep wet and continue scrubbing in accordance with manufacturer's application instructions.
 - 2) Flush and remove excess material.
 - 3) Damp mop to remove any streaks.
 - 4) Do not allow residue to dry on floor surface.
 - 5) Thoroughly rinse, using clean water, to remove all residue.
 - b. After rinsing, allow floor to dry completely and apply second coat following the same procedures.
 - c. Final floor finish shall have uniform sheen without streaking, stains or white residue.

3.2 FINISHES

- A. Concrete Finishes for Vertical Wall Surfaces:
 1. General: Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
 2. Finish #1 - As cast rough form finish:
 - a. Selected forming materials are not required.
 - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/4 IN.
 - 3) Air pockets deeper than 1/4 IN.
 - 4) Rock holes deeper than 1/4 IN.
 - c. Chip or rub off fins exceeding 1/4 IN in height.
 - d. Use at unexposed surfaces such as foundations and backfilled surfaces of walls not to be waterproofed.
 3. Finish #2 - As cast form finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture.
 - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.

- b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/4 IN or larger than 1/4 IN DIA.
 - 3) Air pockets deeper than 1/4 IN or larger than 1/4 IN DIA.
 - 4) Rock holes deeper than 1/4 IN or larger than 1/4 IN DIA.
 - 5) Scabbing.
 - c. Chip or rub off fins exceeding 1/8 IN in height.
 - 1) Finish shall provide uniform color and texture.
 - d. Provide this finish for:
 - 1) Inside walls of wet wells, basins, clarifiers, tanks, and manholes.
 - 2) Walls being waterproofed.
 - 3) Exposed surfaces not specified to receive another finish.
 - 4. Finish #5 - Smooth form finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture.
 - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
 - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs, air pockets, rock holes and other holes deeper than 1/16 IN or larger than 1/16 IN DIA.
 - 3) Scabbing.
 - c. Chip or rub off fins exceeding 1/16 IN in height.
 - d. Provide this finish for:
 - 1) All surfaces which are to be painted, are to receive tank linings or are to remain exposed to view.
 - e. Construct mock-up per the Mock-Ups paragraph in the QUALITY ASSURANCE Article in PART 1 of this Specification Section.
- B. Related Unformed Surfaces (Except Slabs):
- 1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
 - 2. Float surface to a texture consistent with that of formed surfaces.
 - a. If more than one (1) finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
 - 3. Continue treatment uniformly across unformed surfaces.
- C. Concrete Finishes for Horizontal Slab Surfaces:
- 1. General:
 - a. Tamp concrete to force coarse aggregate down from surface.
 - b. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
 - c. Dusting of surface with dry cement or sand during finishing processes not permitted.
 - 2. Unspecified slab finish:
 - a. When type of finish is not indicated, use following finishes as applicable:
 - 1) Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 - 2) Surfaces intended to receive roofing, except future floors, or waterproofing membranes: Floated finish.
 - 3) Floors and roof surfaces which are future floors intended as walking surfaces or for reception of floor coverings: Troweled finish.
 - 4) Garage floors and ramps: Broom or belt finish.
 - 5) Exterior slabs, sidewalks, platforms, steps and landings, and ramps, not covered by other finish materials: Broom or belt finish.
 - 6) All slabs to receive a floated finish before final finishing.

3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
4. Floated finish:
 - a. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
 - b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations.
 - 1) Use wood or cork float.
 - c. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two (2) different angles.
 - d. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
 - e. Refloat slab immediately to a uniform texture.
5. Troweled finish:
 - a. Float finish surface to true, even plane.
 - b. Power trowel, and finally hand trowel.
 - c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
 - d. Perform additional trowelings by hand after surface has hardened sufficiently.
 - e. Final trowel when a ringing sound is produced as trowel is moved over surface.
 - f. Thoroughly consolidate surface by hand troweling.
 - g. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
 - h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering by grinding.
6. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
7. Underside of concrete slab finish:
 - a. Match finish as specified for adjacent vertical surfaces.
 - b. If more than one (1) finish occurs immediately adjacent to underside of slab surface, provide surface with most stringent formed surface requirement.

3.3 FIELD QUALITY CONTROL

- A. Horizontal slab finishes will be accepted provided:
 1. Applicable specification requirements are satisfied.
 2. Water does not pond in areas sloped to drain.
 3. Gap between a 10 FT straightedge placed anywhere and the finished surface does not exceed:
 - a. Class A tolerance: 1/8 IN.
 - b. Class B tolerance: 1/4 IN.
 - c. Class C tolerance: 1/2 IN.
 4. Accumulated deviation from intended true plane of finished surface does not exceed 1/2 IN.
 5. Accuracy of floor finish does not adversely affect installation and operation of movable equipment, floor supported items, or items fitted to floor (doors, tracks, etc.).
- B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected.
 1. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.

3.4 PROTECTION

- A. All horizontal slab surfaces receiving chemical floor sealer shall be kept free of traffic and loads for minimum of 72 HRS following installation of sealer.

END OF SECTION

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SECTION 03 41 33
PRECAST AND PRESTRESSED CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast and prestressed concrete.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 – Concrete Testing.
 - 4. Section 03 21 00 - Reinforcement.
 - 5. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 6. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. HB, Standard Specifications for Highway Bridges.
 - 2. American Concrete Institute (ACI):
 - a. 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - b. 318, Building Code Requirements for Structural Concrete.
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 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. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - f. C33, Standard Specification for Concrete Aggregates.
 - g. C150, Standard Specification for Portland Cement.
 - h. C330, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - i. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - j. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
 - 4. American Welding Society (AWS):
 - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
 - c. D1.1, Structural Welding Code - Steel.
 - d. D1.4, Structural Welding Code - Reinforcing Steel.
 - e. D1.6, Structural Welding Code – Stainless Steel.
 - 5. Occupational Safety and Health Administration (OSHA).
 - 6. Precast/Prestressed Concrete Institute (PCI):
 - a. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
 - b. MNL 120, Design Handbook - Precast and Prestressed Concrete.
 - 7. Building code:
 - a. International Code Council (ICC):

- 1) International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:

1. Provide precast and prestressed concrete units produced by an active member of PCI.
2. Plant to be certified by the Precast/Prestressed Concrete Institute, Plant Certification Program, as applicable:
 - a. Certification Code C1: Precast Concrete Products.
 - b. Certification Code C2: Precast Hollow Core and Repetitive Products.
 - c. Certification Code C3: Prestressed Straight Strand Structural Members.
 - d. Certification Code C4: Prestressed Deflected Strand Structural Members.
 - e. Plant shall have been certified within past year from bid date.
3. Plant shall be certified by IAS and shall be acceptable to the Building Code Official to assure compliance with approved fabricator Special Inspection requirements in accordance with the Building Code.
 - a. Plants that are not certified by IAS or not acceptable to the Building Code Official may be acceptable to work on the Project, provided:
 - 1) Plant meets all remaining qualifications.
 - 2) Contractor reimburses the Owner the cost of Special Inspection services.
4. 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 three years.
5. Assure manufacturer's testing facilities meet requirements of ASTM E329.
6. 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.
7. Welding operators to have passed qualification tests for type of welding required during the previous 12 months prior to commencement of welding.
8. Engineer for all precast or prestressed members: Professional Engineer licensed in the State of Idaho.
 - a. Engineer to have minimum five years of experience in design of precast and prestressed members with scope similar to this Project.
9. Precast erector:
 - a. Minimum three years of experience with projects of similar size and complexity.

1.3 DEFINITIONS

- A. Slabs: May refer to hollow core slabs or solid flat slabs, prestressed or non-prestressed.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
 - a. Acknowledgement 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.
 - a. Calculations to be sealed by a professional Structural Engineer registered in the State in which the Project is constructed.
 - b. 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.
 - c. Indicate the following:
 - 1) Design for maximum moment, maximum shear and maximum torsion.
 - 2) Final top and bottom flexural stresses resulting from the stresses due to maximum moment and prestress force.
 - 3) Ultimate moment capacity.
 - 4) 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.
 - 5) 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.
5. Submit test results, when so required on Drawings, showing that embedded connection items will adequately support the indicated loads.
 - a. Connection items to have an ultimate load capacity of at least two times the required indicated load.
6. Concrete mix design(s) including submittal information defined in Specification Section 03 05 05.
7. Fabricator's quality control documentation for special inspections as required by the Building Code Chapter 17.
8. Copies of source quality control tests.
9. Certification of manufacturer's testing facility qualifications.

PART 2 - PRODUCTS

2.1 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 Div., TRW, Inc.
 - b. KSM Division, Omark Industries.
 - c. Or equal.
 2. Bearing pads:
 - a. JVI, Inc.
 - b. Or equal.

2.2 MATERIALS

- A. Embedded Steel Plates and Shapes:
 1. ASTM A36.
- B. Bearing Pads:
 1. Under slabs:
 - a. Plastic bearing strips.
 - b. Minimum compressive strength: 8,000 PSI with no fracture at 26,000 PSI.
 - c. Korolath of New England, Inc., or equal.
 2. For all other locations:
 - a. Random, fiber-reinforced elastomeric pads.
 - b. Preformed, randomly oriented synthetic fibers set in elastomer.
 - c. Capable of supporting a compressive stress of 3000 PSI with no cracking, splitting, excessive bulging or delaminating in the internal portions of the pad.

- d. Size pad to keep a minimum stress 200 PSI under minimum dead load.
 - e. Masticord as manufactured by JVI, Inc., or equal.
- C. Cement:
- 1. Comply with ASTM C150, Type I or III.
 - 2. Type II cement to be used in the following precast units:
 - a. Precast weir troughs.
- 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.
 - 2. Manufacture and test strands in accordance with ASTM A416.
- H. Reinforcing Steel and Welded Wire Reinforcement: See Specification Section 03 21 00.
- 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 or ASTM A1064.
 - 2. Minimum tensile strength: 80,000 PSI.
 - 3. Minimum yield strength: 70,000 PSI.
- K. Electrodes:
- 1. E70 series conforming to AWS A5.1/A5.1M or AWS A5.5/A5.5M for welding steel shapes and plates.
 - 2. E90 series conforming to AWS A5.5/A5.5M for welding rebar.
- L. Concrete sand cement grout in keyways between slabs.
- 1. See Specification Section 03 31 30.

2.3 DESIGN

- A. General Design Requirements:
- 1. Design units and connections in strict accordance with ACI 318 and the PCI MNL 120.
 - 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.
 - a. 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.
 - a. Where not indicated, design and provide all reinforcing and prestressing strands subject to approval of Engineer.
 - 5. Due to presence of corrosive atmosphere, design prestressed members where indicated on Drawings for no tension in top and bottom of members resulting from loads indicated on Drawings and in this Specification Section.

6. Design connections to allow rotation and/or movement as appropriate to avoid damage to connections, supporting members, joint sealants and other building components.

2.4 MIXES

- A. See Specification Section 03 31 30.
- B. Do not begin fabrication of units until concrete mix design(s) have been approved by 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 MNL 120.
- C. Cast all members in smooth rigid forms which will provide straight, true members of uniform thickness and uniform color and finish.
- D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.
- E. Finish all repairs smooth and to match adjacent surface texture and color.
- F. Where units are to receive concrete topping, provide units having heavy broom finish on top surface for bond.
 1. Provide roughness of top surface to provide bond with topping and design for horizontal shear at topping and unit interface in accordance with requirements of ACI 318, Horizontal Shear Strength paragraph.
 2. Make all other surfaces smooth.
- G. Incorporate embedded plates, angles, and flange welding strips into members at time of manufacture.
 1. Provide embedded items as shown on the Drawings unless prior approval is received from Engineer to do otherwise.
 2. Provide flange welding strips on all flanged edges of all double tee units as indicated on Drawings.
 3. Space strips as shown on Drawings.
 4. Cast lifting handles into units at or near support points.
 - a. Remove lifting handles after units are erected.
- H. Cast openings larger than 6 IN SQ or 6 IN DIA in units at time of manufacture.
 1. Make smaller openings by neat cutting or neat drilling by trades requiring them.
 2. Coordinate sizes and locations of all openings before fabrication of units.
- I. 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.
- J. 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.
- K. Weld steel shapes and plates per AWS D1.1 or D1.6 and reinforcing steel per AWS D1.4.
- L. Minimum concrete compressive strength at time of strand release: 3500 PSI.

- M. Mark each unit as indicated on the erection plans.
 - 1. Place mark on non-exposed-to-view surface.
- N. Coat or finish ends of exposed prestressing strands to prevent rusting.
- O. Fabricate the following types of precast and prestressed units (all units to be made with normal weight concrete unless noted otherwise on Drawings):
 - 1. Precast items shown on Drawings including but not limited to:
 - a. Splash blocks.
 - 2. Precast junction boxes and precast vaults as shown on Electrical Drawings or as noted in Specifications.
 - 3. Precast utility vaults, precast manholes, and other miscellaneous precast items as shown on Civil Drawings or as noted in Specifications.

2.6 CIVIL DRAWINGS OR AS NOTED IN SPECIFICATIONS. SOURCE QUALITY CONTROL

- A. During production of precast concrete units, conduct strength tests of concrete placed in units as required in Specification Section 03 05 05 for concrete placed during fabrication.
 - 1. Results of strength tests to be sent immediately to Engineer, Contractor and Owner.
 - 2. Test reports to indicate units they represent.
- B. When approved by Engineer, strength tests may be made by precast manufacturer after he has submitted certification that his testing facilities meet the requirements of ASTM E329.
- C. Conduct tests on precast concrete using the following procedures:
 - 1. If the precast manufacturer's quality control program requires more frequent or more stringent testing requirements, the manufacturer's quality control program will take precedence over the specific type of test.
 - a. Precast manufacturer to employ services of an independent testing laboratory to perform concrete testing for manufacturer's production procedures (not listed below) and quality control program.
 - 2. If the precast fabrication plant is not certified by IAS and acceptable to the Building Code Official, Owner will employ and pay for precast concrete production special inspection.
 - a. Coordinate with Owner's special inspector.
 - 1) Provide minimum 7 calendar days notice prior to the start of fabrication.
 - 2) Provide minimum 24 HRS notice prior to fabrication of any precast members.
 - 3. If precast fabrication plant is certified by IAS and acceptable to the Building Code Official, perform concrete tests as specified in Section 03 05 05. Frequency of tests: Per PCI MNL-116 or PCI MNL-117 as applicable.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify acceptability and location of supports to receive units.
 - 1. Check bearing surfaces to determine that they are level and uniform.
- B. Verify compressive strengths of concrete and masonry supports.
 - 1. Do not start erection of units until supports have reached their 28 day required compressive strengths.

3.2 ERECTION

- 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.
 - 1. Do not damage units or existing construction during erection.
 - 2. Erect units using lifting handles cast into the units.
- E. Provide a 1/2 IN thick bearing pad on the top of all precast concrete columns.
- F. Pad to cover entire top surface of column except hold pad back 1 IN from face of column all around.
- G. After erection, verify that there is no direct contact between bottom of units and supporting members.
 - 1. Where direct contact occurs, install additional layers of bearing material to raise units off supports.
- H. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.
- I. Fill all keyways between slabs with concrete sand cement grout.
 - 1. See Specification Section 03 31 30.
- J. After all precast units are erected and all precast unit connections have been made, coat all exposed surfaces of the connections.
 - 1. See Specification Section 09 96 00.

3.3 FIELD QUALITY CONTROL

- A. Testing and Special Inspections: See Section 01 45 33.
- B. 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

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DIVISION 04

MASONRY



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SECTION 04 01 20
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 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Use experienced workmen familiar with product and its application.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Manufacturer's application instructions.
 - b. Manufacturer's dilution recommendations.
 - c. Manufacturer's recommendations on neutralizing rinse.
- B. Certifications:
 - 1. Certification that Contractor is experienced in this type of masonry cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Cleaning solution, detergent type:
 - a. PROSOCO, Inc.
 - b. Diedrich Technologies, Inc.
 - c. Or equal.
 - 2. Cleaning solution for manganese or vanadium stained masonry:
 - a. PROSOCO, Inc.
 - b. Diedrich Technologies, Inc.
 - c. Or equal.

2.2 MATERIALS

- A. Detergent-Type Cleaning Solution: PROSOCO, Inc. "Sure Klean #600 IN detergent masonry cleaner.
- B. Manganese or Vanadium-Stained Masonry: PROSOCO, Inc. "Vanatrol."
- C. Water: Potable.
- D. Neutralizing rinse as required by manufacturer.

2.3 MIXES

- A. Dilute cleaning solution with potable water at rate which will provide for the weakest solution allowable for cleaning wall.
- B. If project conditions require solution of greater than 5 PCT acid, obtain permission from Engineer in writing prior to applying solution to wall surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Allow 28 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. Protect adjacent surfaces subject to potential damage by cleaning solution.
- 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 04 05 13
MASONRY MORTAR AND GROUT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Masonry mortar.
 - 2. Masonry grout.
 - 3. Integral water repellent admixture.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 04 22 00 - Concrete Masonry.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - b. C144, Standard Specification for Aggregate for Masonry Mortar.
 - c. C150/C150M, Standard Specification for Portland Cement.
 - d. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - e. C270, Standard Specification for Mortar for Unit Masonry.
 - f. C404, Standard Specification for Aggregates for Masonry Grout.
 - g. C476, Standard Specification for Grout for Masonry.
 - h. C1019, Standard Test Method for Sampling and Testing Grout.
 - i. C1093, Standard Practice for Accreditation of Testing Agencies for Masonry.
 - j. C1384, Standard Specification for Admixtures for Masonry Mortars.
 - 2. Masonry Standards Joint Committee (MSJC):
 - a. Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602); referred to herein as MSJC Specification.
 - 3. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
 - 1. Preconstruction Testing Laboratory shall be an independent agency qualified in accordance with ASTM C1093 for performing the testing indicated.
 - a. Testing Laboratory shall have a minimum of 10 years of experience in the testing of mortar and grout.
 - b. Technician conducting tests shall have minimum of five years of experience in the testing of mortar and grout.
- C. Mock-Ups:
 - 1. Provide mortar and grout for mock-up specified in Specification Section 04 22 00.

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 Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. General:
 - 1) Product data for cementitious materials.
 - 2) Source or producer of aggregates and gradation.
 - 3) Integral water repellent manufacturer's dosage rate.
 - c. Proposed mortar mix design:
 - d. Proposed masonry grout mix design.
 - 3. Test results:
 - a. Preconstruction mortar test results.
 - b. Preconstruction masonry grout test results.
- B. Samples:
 - 1. Colored mortar samples for color selection by Engineer.
 - a. Color card and plastic simulations are not acceptable.
- C. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Qualifications of testing lab and technician.
 - 3. Test results and inspection reports per Specification Section 01 45 33.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location.
 - 1. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver preblended, dry mixes in moisture-resistant containers.
 - 1. Store preblended, dry mixes in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement:
 - 1. ASTM C150/C150M, Type I or II.
 - 2. No air entrainment.
 - 3. Natural color.
 - 4. Maximum percent of alkalis: 0.60 in accordance with ASTM C150/C150M, Table 2.
- B. Hydrated Lime:
 - 1. ASTM C207, Type S.
 - 2. Type SA not acceptable.
 - 3. Lime substitutes are not acceptable.
- C. Mortar Aggregate: ASTM C144, free of gypsum.
- D. Grout Aggregate: ASTM C404.
- E. Water: Potable.
- F. Integral Water Repellent Admixture:

1. Liquid polymeric admixture: ASTM C1384.
2. Verify compatibility with liquid water repellent admixture being used in the fabrication of concrete masonry units.

2.2 MIXES

- A. Mortar and grout shall comply with MSJC Specification and Building Code.
- B. Type "S" mortar shall be used:
 1. Comply with ASTM C270, Table No. 1, Cement-Lime Mortar.
 - a. Do not use masonry cement or mortar cement.
 - b. No fly ash additives will be accepted.
 2. Mix materials minimum of three minutes and maximum of five minutes.
 3. Adjust consistency to satisfaction of mason.
 4. Do not use admixtures unless otherwise indicated.
 5. Provide integral water repellent admixture in mortar used for:
 - a. Exterior concrete masonry work.
 - b. Interior concrete masonry work in wet areas.
 6. Do not use integral water repellent admixture in mortar for brick.
- C. Masonry Grout:
 1. ASTM C476.
 - a. Minimum 28-day compressive strength: 2,000 PSI.
 - b. Slump: 8 to 11 IN.
 2. Mix 5 minutes minimum.
 3. No admixtures allowed.
 4. At Contractor's option, premixed or preblended grout meeting the above minimum requirements may be used.

2.3 SOURCE QUALITY CONTROL

- A. Perform preconstruction laboratory tests on proposed masonry mortar and grout prior to start of masonry work.
 1. Perform tests far enough in advance so that any necessary retesting can be accomplished before masonry construction begins.
 - a. Test mortar per ASTM C270.
 - b. Test grout per ASTM C1019.
- B. Source Limitations for Mortar Materials:
 1. Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and MSJC Specification.
- B. Mortar:
 1. If standard gray mortar begins to stiffen, it may be retempered by adding water and remixing unless prohibited by water repellent admixture manufacturer.
 - a. Standard gray mortar shall not be retempered more than one time.
 - b. Colored mortar shall not be retempered.
 2. All mortar must be used within 2-1/2 HRS maximum after initial mixing per MSJC Specification.
 3. Engineer reserves right to alter mix design based on initial rate of absorption of masonry units.
 4. Use colored mortar for all exterior walls.

- C. Masonry Grout:
1. Use grout within 1-1/2 HRS maximum after initial mixing.
 2. Use no grout after it has begun to set.
 3. Do not retemper grout after initial mixing.
 4. Place grout in lifts not exceeding 4 FT.
 5. Use coarse grout in spaces with least dimension over 2 IN.
 6. Consolidate all grout while installing.
 - a. Consolidate grout pours 12 IN or less in height by mechanical vibration or by puddling.
 - b. Consolidate grout pours exceeding 12 IN in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

3.2 FIELD QUALITY CONTROL

- A. Masonry Mortar and Grout Testing and Inspection:
1. Testing and inspection services will be provided by the Owner's special masonry inspector.
 - a. Do not include in the bid price the cost of these services.
 2. Testing and inspection shall include, but is not limited to:
 - a. Observe proportions of site-prepared mortar and grout.
 - b. Observe grout space prior to grouting.
 - c. Grout compressive strength sampling, testing and reporting per ASTM C1019.
 - 1) One strength test shall be the average of three specimens from the same sample, tested at 28 days.
 - d. Grout slump test sampling, testing, and reporting per ASTM C143/C143M.
 - e. Frequency of sampling: One sample (three specimens) collected each grouting operation during masonry construction.
 3. Reporting: Special inspector to submit test results and inspection reports per Specification Section 01 45 33.

END OF SECTION

SECTION 04 05 23
MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Masonry accessories.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 04 22 00 - Concrete Masonry.
 - 4. Section 05 50 00 - Metal Fabrications.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. A951, Standard Specification for Steel Wire for Masonry Joint Reinforcement.
 - c. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - d. A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - e. D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - f. D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - g. D2000, Standard Classification System for Rubber Products in Automotive Applications.
 - h. D2240, Standard Test Method for Rubber Property—Durometer Hardness.
 - 2. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.
- B. Mock-Ups:
 - 1. Provide specified products for inclusion into mock-up panels required by Specification Section 04 22 00.
 - 2. Coordinate with built-in items and veneer coursing.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's data sheet on each product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Masonry anchors, horizontal joint reinforcing and miscellaneous anchors:
 - a. Heckman.
 - b. Hohmann & Barnard, Inc.
 - c. Wire Bond.
 - d. Or equal.
 2. Preformed control joint inserts:
 - a. Hohmann & Barnard, Inc.
 - b. Wire Bond.
 - c. Or equal.
 3. Grout screen:
 - a. Wire Bond.
 - b. Heckman Building Products.
 - c. Hohmann & Barnard, Inc.
 - d. Or equal.

2.2 MANUFACTURED UNITS

- A. Horizontal Joint Reinforcing:
1. General:
 - a. Conform to ASTM A951.
 - b. Cold drawn steel wire, ASTM A82.
 - c. 9 GA side rods.
 - d. 9 GA cross rods.
 - e. Hot-dipped galvanized, ASTM A153/A153M.
 - f. Prefabricated corner and tee sections with minimum length of 30 IN from point of intersection.
 2. Single wythe wall joint reinforcing: Ladder design.
- B. Rigid Steel Masonry Anchors:
1. 1 IN by 1/4 IN with ends turned up 2 IN.
 2. Hot-dipped galvanized steel, ASTM A153/A153M.
 3. Length:
 - a. 24 IN unless noted otherwise.
 - b. Where wall conditions such as jambs or other obstructions preclude the use of 24 IN anchors, shorter anchors may be used.
- C. Mesh Wall Ties:
1. Hot-dipped galvanized steel, ASTM A153/A153M.
 2. 16 GA, 1/2 IN square mesh.
 3. Width: 2 IN less than nominal wall thickness.
 4. Length: As necessary to embed minimum 6 IN into each wall.
- D. Grout Screen:
1. Polypropylene monofilament.
 2. 1/4 x 1/4 IN mesh.
 3. Width of grout screen to be 2 IN less than nominal width of CMU.
- E. Preformed Rubber Control Joint Inserts:
1. ASTM D2000, M2AA-805.
 2. Hardness: ASTM D2240, Shore A Durometer, 80 +/-5.
 3. Ultimate elongation: 350 PCT, ASTM D412.

4. Tensile strength: 1000 PSI, ASTM D412.
5. Hohmann & Barnard #RS Series.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Butt joints of preformed control joint inserts tightly together and secure with adhesive or sealant acceptable to insert manufacturer.
- C. Reinforcing Masonry:
 1. General:
 - a. Provide continuous horizontal joint reinforcing in all concrete masonry wall construction.
 - 1) 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.
 - a) For interior partitions, the "exterior" side of the wall is considered the side having the most corrosive atmosphere or the corridor side of the wall.
 - 2) Lap reinforcement minimum of 12 IN at ends.
 - a) Remove cross wires on one side of the lap splice and bend the side rods slightly so the lap is provided with 12 IN of uninterrupted wire lap occurring in the same plane.
 - 3) Do not bridge control joints with horizontal joint reinforcing.
 - 4) Do not bridge expansion joints with horizontal joint reinforcing.
 - 5) At corners and wall intersections use prefabricated "L" and "T" horizontal joint reinforcing sections.
 - 6) Cut and bend as necessary.
 - b. Install reinforcing at 16 IN OC vertically unless noted otherwise on Drawings.
 - c. Install reinforcing 8 IN OC vertically for a minimum of 24 IN at starter courses.
 - 1) Do not install horizontal joint reinforcing in veneer mortar joint having through-wall flashing.
 - d. In concrete masonry, install additional horizontal joint reinforcing and adjustable pintle veneer anchors 16 IN OC in courses on each side of vertical control joints and on each jamb of openings for full height of joint or opening.
 - 1) Alternate with normal wall horizontal joint reinforcing.
 - 2) Extend reinforcing minimum 32 IN beyond joint or jambs of opening.
 - e. In concrete masonry, reinforce masonry openings over 12 IN wide with horizontal joint reinforcing and adjustable pintle veneer anchors placed in three horizontal joints above lintel and two horizontal joints below sill.
 - 1) Extend minimum of 32 IN beyond jambs of opening.
 2. Reinforcing concrete masonry:
 - a. Install reinforcing bars where indicated on Drawings.
 - 1) Provide means necessary to ensure position of vertical steel reinforcing meets requirements of Building Code.
 - b. At intersecting load-bearing walls, provide rigid steel anchors 16 IN OC vertically, embed ends in grout filled cores.
 - 1) Alternate rigid steel anchors with horizontal joint reinforcing.
 - c. At intersecting non-load bearing walls or at intersecting load bearing/non-load bearing walls provide mesh wall ties in mortar joint at 16 IN OC vertically.
 - 1) Extend minimum 6 IN into each wall.
 - 2) Alternate mesh wall ties with horizontal joint reinforcing.
 - d. Anchor intersecting concrete masonry to intersecting cast-in-place or precast concrete using dovetail slots and anchors.
 - 1) Provide dovetail anchors at 16IN OC or as noted on Drawings.

3. Repair all galvanized coatings damaged as a result of welding.
 - a. See Specification Section 05 50 00 for galvanizing repair system.

END OF SECTION

SECTION 04 05 50
COLD AND HOT WEATHER MASONRY CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold weather protection.
 - 2. Hot weather protection.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Brick Industry Association (BIA):
 - a. Technical Note 1, Cold and Hot Weather Construction.
 - 2. Masonry Standards Joint Committee (MSJC):
 - a. Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602); referred to herein as MSJC Specification.
 - 3. National Concrete Masonry Association (NCMA):
 - a. TEK 3-1C, All Weather Concrete Masonry Construction.

1.3 DEFINITIONS

- A. As defined in MSJC Specification.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ERECTION AND APPLICATION

- A. General:
 - 1. Comply with NCMA TEK 3-1C recommendations and practices.
 - 2. Do not use frozen or ice coated materials.
 - 3. At end of each day or at shutdown, cover tops of all walls not enclosed or sheltered with clear polyethylene minimum 6 MIL thick.
 - a. Extend down each side of wall minimum of 16 IN and secure.
- 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 DEGF within protected areas.
 - 3. Remove all temporary facilities after completion of work.
- C. Cold Weather Construction and Protection Requirements:
 - 1. Prior to and during installation:
 - a. Air temperature 32 to 40 DEGF: Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 DEGF.
 - b. Air temperature 25 to 32 DEGF:
 - 1) Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 DEGF.

- 2) Maintain mortar temperatures above freezing until used.
 - c. Air temperature below 25 DEGF:
 - 1) Heat mixing water and aggregate to produce mortar temperatures between 40 and 120 DEGF.
 - 2) Maintain mortar temperatures above freezing until used.
 - 3) Maintain temperature of units until laid at not less than 40 DEGF.
 - 4) Provide heat on both sides of walls under construction to maintain air temperature above freezing.
 - 5) Provide windbreaks or shelters when wind is in excess of 15 MPH.
 - a) Wind breaks or shelters shall be translucent.
 - 2. After installation:
 - a. Air temperature 32 to 40 DEGF: Protect from rain or snow for not less than 24 HRS by covering with weather-resistive translucent membrane.
 - b. Air temperature 25 to 32 DEGF: Completely cover with translucent weather-resistive membrane for not less than 24 HRS.
 - c. Air temperature 20 to 25 DEGF: Completely protect with insulating blankets for not less than 24 HRS or provide other protection approved by Engineer.
 - d. Air temperature below 20 DEGF:
 - 1) Provide enclosed translucent shelters and heating to maintain air temperature on each side of wall above 32 DEGF for 24 HRS.
 - 2) Do not allow rapid drop in temperature after removal of heat.
 - e. Promptly repair all tears, holes, etc., to translucent membrane and shelter using compatible patching material and tape as recommended by membrane manufacturer.
- D. Hot Weather Construction and Protection Requirements:
- 1. Comply with requirements of NCMA, BIA and MSJC Specification.
 - 2. Storage and preparation of materials.
 - a. Cover or shade masonry units and mortar materials from direct sun.
 - b. Maintain sand in a damp loose condition.
 - 1) Sand moisture shall be maintained at minimum 8 PCT.
 - 2) Sprinkle with cool water as required to maintain moisture content.
 - c. Use cool water for mixing mortars.
 - d. Avoid using tools and equipment that have been sitting in the sun.
 - 1) Sprinkle mortar boards, mortar pans, wheel barrows, mixers, etc., with cool water.
 - e. Do not wet concrete masonry units prior to use.
 - 3. Installation:
 - a. Place masonry units within one minute of the spreading of the mortar.
 - 1) Mortar beds shall not be spread more than 4 FT ahead of the masonry unit being placed.
 - b. Provide wind screens and shading partitions as required to eliminate direct sunlight exposure.
 - c. Wet installed units using fog spray of clean water.
 - d. Cover installed work immediately after installation to slow rate of loss of moisture from units.
 - e. Fog-spray new masonry work until damp.
 - 1) Repeat fog spraying minimum of three times per day until masonry work has cured for 72 HRS.
 - 2) In high humidity conditions, Engineer reserves the right to discontinue fog spraying if operation is found to be introducing excessive amounts of moisture into the Work.

END OF SECTION

SECTION 04 22 00
CONCRETE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Concrete masonry construction (CMU), including:
 - a. Standard concrete masonry.
 - b. Pre-colored masonry.
 - c. Split-face masonry.
 - d. Ground-face masonry.
 2. Integral water repellent admixture.
 3. Masonry special inspection.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 03 21 00 - Reinforcement.
 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 5. Section 04 01 20 - Masonry Cleaning.
 6. Section 04 05 13 - Masonry Mortar and Grout.
 7. Section 04 05 23 - Masonry Accessories.
 8. Section 04 05 50 - Cold and Hot Weather Masonry Construction.
 9. Section 07 21 00 - Building Insulation.
 10. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. ASTM International (ASTM):
 - a. C33, Standard Specification for Concrete Aggregates.
 - b. C55, Standard Specification for Concrete Building Brick.
 - c. C90, Standard Specification for Loadbearing Concrete Masonry Units.
 - d. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - e. C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
 - f. C1357, Standard Test Methods for Evaluating Masonry Bond Strength.
 - g. E514, Standard Test Method for Water Penetration and Leakage Through Masonry.
 2. Masonry Standard Joint Committee (MSJC):
 - a. Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602); referred to herein as MSJC Specification.
 3. National Concrete Masonry Association (NCMA):
 - a. TEK 2-3A, Architectural Concrete Masonry Units.
 - b. TEK 3-4B, Bracing Concrete Masonry Walls During Construction.
 - c. TEK 8-2A, Removal of Stains from Concrete Masonry.
 - d. TEK 8-3A, Control and Removal of Efflorescence.
 4. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.
 5. Concrete masonry unit manufacturer shall be licensed or qualified, in writing, by manufacturer of integral water repellent admixture to produce masonry units containing manufacturer's admixture.

- a. Concrete masonry unit manufacturer shall have a minimum of five years of experience producing masonry units containing manufacturer's admixture.
- B. Mock-Ups:
- 1. Prior to permanent wall construction, construct mock-up.
 - a. Construct mock-up on a concrete slab as necessary to demonstrate construction details.
 - 1) Minimum slab thickness: 4 IN.
 - b. Mock-up shall show full color range, texture and bond pattern(s) of all masonry specified.
 - c. Mock-up shall be as large as required to properly display all conditions required by the building masonry construction.
 - 1) Minimum 4 FT high x 8 FT long.
 - a) Return corners and intersections minimum 4 FT.
 - 2) Mock-up shall demonstrate:
 - a) Outside corner condition.
 - b) Inside corner condition.
 - c) Intersection of interior masonry partition.
 - d) Jamb condition demonstrating lintel bearing and flashing.
 - e) Masonry control joint.
 - d. Include all special corners and other special CMU detailing shown on Drawings.
 - e. Include all types of masonry shown on Drawings, including:
 - 1) Pre-colored masonry.
 - 2) Split-face masonry.
 - 3) Ground-face masonry.
 - f. Mock-up shall include, as a minimum:
 - 1) All types of masonry.
 - a) All special shapes.
 - 2) Colored mortar
 - 3) Vertical wall reinforcing with grouted cell.
 - 4) Typical bond beam construction.
 - 5) Typical lintel construction.
 - 6) Positioning, securing and lapping of reinforcing steel.
 - 7) Masonry accessories:
 - a) Horizontal joint reinforcing.
 - (1) Positioning and lapping of joint reinforcing.
 - b) Typical control joint construction.
 - c) Mesh wall ties.
 - d) Rigid steel masonry anchors.
 - 8) Insulation.
 - 9) Cleaning of masonry work.
 - 2. Step construction of mock-up to allow observation of all components.
 - 3. Mock-up shall constitute minimum standard of quality for actual construction.
 - a. Maintain mock-up during construction.
 - 4. If not acceptable, construct additional mock-ups as required.
 - 5. Remove when directed by Engineer.
- C. All masonry units of any one particular type, color or face style shall be from the same production run.
 - 1. Special shapes shall be factory fabricated unless noted otherwise.

1.3 DEFINITIONS

- A. Definitions to be in accordance with Standard Unit Nomenclature Table 1, NCMA TEK 2-3A.

1.4 SUBMITTALS

- A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Manufacturer's information on aggregate and cement type used in manufacture.
 - b. Data sheet on each type of masonry unit, including:
 - 1) Pre-colored masonry.
 - 2) Split-face masonry.
 - 3) Ground-face masonry.
 3. Drawings:
 - a. Scaled (minimum 1/8 IN per foot) plans showing proposed locations of masonry control joints.
 - b. Wall elevations and sections, indicating special shapes, shape part numbers, applicable dimensions.
 4. Certifications:
 - a. Certification that concrete masonry units meet or exceed requirements of standards referenced.
 - b. Certification that fire-resistive rated units meet the requirements of the Building Code.
 - c. Certification that integral water repellent admixture will not affect the use of coloring processes or alter the actual colors of factory colored masonry units.
 - d. Data sheets on integral water repellent admixture being used in masonry unit manufacturing.
 - e. Technical bulletins on cleaning masonry containing integral water repellent.
 - f. Certification of integral water repellent admixture dosage rates from concrete masonry unit producer.
 - g. Concrete masonry producer shall certify that integral liquid water repellent admixture has been provided at dosage rate recommended by admixture manufacturer for use in exterior wall construction.
 5. Qualifications of testing lab and technician.
 6. Test results for all masonry testing.
- B. Samples:
1. Concrete Masonry Finish Samples: Manufacturer's complete offering of colors and textures for each type of masonry specified.
 - a. Minimum 3 IN SQ samples for initial selection.
 - b. Provide two, 8 IN SQ samples if each type of masonry selected for final approval.
 - c. Samples of standard gray masonry will not be required.
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 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. Inspect units upon delivery for damage, to assure color match with mock-up or approved samples, dimensional quality, and trueness of unit.
 1. Remove damaged or otherwise unacceptable units from the Project Site.
- D. Store units in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Standard masonry units:
 - a. Any manufacturer capable of meeting the requirements of this Specification Section.
2. Integral water repellent admixture:
 - a. GCP Applied Technologies, Inc.
 - b. ACM Chemistries, Inc.
 - c. Or equal.

2.2 MATERIALS

- A. Cement: Type I or II Portland, ASTM C150.
- B. Aggregate: ASTM C33.
- C. Reinforcing Bars: Refer to Specification Section 03 21 00.
- D. Mortar: Refer to Specification Section 04 05 13.
- E. Masonry Grout: Refer to Specification Section 04 05 13.
- F. Masonry Accessories: Refer to Specification Section 04 05 23.
- G. Insulation: Refer to Specification Section 07 21 00.
- H. Sealants: Refer to Specification Section 07 92 00.
- I. Integral Concrete Masonry Water Repellent:
 1. Liquid polymeric admixture.
 2. GCP Applied Technologies, Inc., "DRY-BLOCK".
 3. Or equal.

2.3 MANUFACTURED UNITS

- A. General:
 1. Fire resistive units: Fabricate to meet the Building Code.
 2. Fabricated in the manufacturing plant.
 3. Provide square corners unless noted otherwise.
- B. Concrete Masonry Units:
 1. Modular units: ASTM C90.
 - a. Normal weight units: Minimum of 125 LB/CUFT.
 - b. Medium weight units: 105 LB/CUFT to less than 125 LB/CUFT.
 - c. Light weight units are not acceptable.
 2. Color:
 - a. Interior units: Standard gray.
 - b. Exposed exterior units: Precolored, Similar to "Mutual Materials", Mesa Tan.
 3. Design compressive strength: $f'_m=1,500$ PSI minimum.
 - a. Determine in accordance with MSJC Specification.
 - 1) Unit strength method, sampled and tested in accordance with ASTM C140.
 4. Provide masonry units manufactured with integral water repellent admixture for the following exposures:
 - a. Exterior veneer.
 - b. Exterior single-wythe construction.
 - c. Interior areas defined as wet and/or corrosive.
 - 1) See Specification Section 07 92 00 for definition of wet and/or corrosive areas.
 5. Special shapes and faces:
 - a. Corner units.
 - 1) Corner units used in veneer wythe shall have a finished return leg one-half the length of a standard modular stretcher unit.
 - 2) Corner units shall maintain regular modular masonry coursing.
 - b. Finished end units.
 - c. Split face.

- d. Other special shapes as indicated on Drawings or necessary to maintain coursing.
- C. Ground-face Masonry Units (GFMU):
- 1. Factory ground-faces on modular concrete block.
 - 2. Manufacture all ground-face masonry units using integral water repellent admixture.
 - 3. Manufacturer's standard factory applied clear sealer.

2.4 PERFORMANCE AND DESIGN REQUIREMENTS:

- A. Integral Concrete Masonry Water Repellent:
- 1. Water permeance of masonry: Capable of achieving a Class E Rating when evaluated using ASTM E514 with the test extended to 72 HRS, using the rating criteria specified in ASTM E514.
 - 2. Flexural bond strength of masonry: An increase of 10 PCT, minimum, in masonry flexural bond strength shall occur as a result of adding integral water-repellent concrete masonry and mortar admixtures when compared to a control (containing no admixtures) concrete masonry and mortar tested in accordance with ASTM C1357.
 - 3. Compressive strength validation shall be per unit strength method.
 - 4. Drying shrinkage of masonry: Maximum 5 PCT increase in drying shrinkage of the concrete masonry units shall occur as a result of adding integral water repellent concrete masonry admixture when compared to a control (containing no admixtures) concrete masonry when tested in accordance with ASTM C426.
 - 5. Grout shear bond strength: Maximum 5 PCT decrease in grout shear bond strength shall occur as a result of adding integral water repellent admixture to the concrete masonry units when compared to a control (containing no admixtures).

PART 3 - EXECUTION

3.1 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.
- 1. Properly locate openings, movement type joints, returns, and offsets.

3.2 INSTALLATION

- A. General:
- 1. Build in flashing, reinforcing, and related accessory items.
 - a. See Specification Section 04 05 23 for installation of accessory items.
 - 2. Perform all cutting using masonry saw blades.
 - 3. Drill holes using masonry drill bits or core drill.
 - a. Holes made by chipping unit will not be accepted.
 - 4. Install field units in running bond, unless noted otherwise.
 - a. Provide special coursing where indicated on the Drawings.
 - 5. Install ground-faced units in running bond as shown on Drawings.
 - 6. Cut as required to maintain bond pattern.
 - 7. Use solid units where cutting or laying would expose holes and as noted on Drawings.
 - 8. Avoid use of less than half size units, whenever possible.
 - 9. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
 - 10. Provide units of uniform color, within the range demonstrated on the approved mock-up.
 - 11. Do not wet concrete masonry units.
 - 12. Build chases and recesses as indicated and required for work of other trades.
 - a. Provide not less than 8 IN of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses unless detailed otherwise on the Drawings.
- B. Concrete Masonry Units:
- 1. Grout solid all cells containing steel reinforcing and as indicated on Drawings.
 - a. Refer to Specification Section 04 05 13 for grouting.

- C. Laying and Tooling:
1. Lay masonry units with completely filled bed and head joints.
 - a. Provide full mortar bed on all block cross webs and completely fill head joints.
 - 1) Do not slush head joints.
 - 2) Protect cells requiring grout fill from mortar droppings.
 - 3) Omit mortar from head joint at weep joint opening.
 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 and in joints concealed by insulation in cavity wall construction.
 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 grout screen in joint below and fill core solid with mortar.
- D. Control Joints and Sealants:
1. Provide vertical expansion, control and isolation joints where indicated on Drawings.
 2. Where not indicated on Drawings, submit proposed control joint locations in accordance with the following requirements:
 - a. Provide control joints at maximum 24 FT OC.
 - b. Provide at all T intersections.
 - c. Locate joints so as to allow lintels and bond beams above and below openings to extend beyond the opening as indicated on the Drawings without control joints thru the lintel or bond beam.
 3. Rake out mortar in joint.
 4. Refer to Specification Section 07 92 00 for sealant installation requirements.
 - a. Seal control and expansion joints.
- E. 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.
- 6. Maximum variation in mortar joint width:
 - a. Bed joints: 3/32 IN in 10 FT.
 - b. Head joints:
 - 1) Minus 1/8 IN.
 - 2) Plus 1/8 IN.
- F. Protect against weather when work is not in progress.
 - 1. During inclement weather conditions, cover top of walls with translucent waterproof membrane.
 - 2. See Specification Section 04 05 50.
- G. Protect against cold/hot weather as specified in Specification Section 04 05 50.

3.3 FIELD QUALITY CONTROL

- A. Bracing Concrete Masonry Walls During Construction:
 - 1. At a minimum, provide bracing in accordance with NCMA TEK 3-4B.
 - 2. Contractor is responsible for adequately bracing all masonry during construction.
- B. Remove and replace loose, stained, damaged and other unacceptable units as directed by Engineer.
 - 1. Provide new units to match.
 - 2. Install in fresh mortar.
 - 3. Point to eliminate evidence of replacement.
- C. Special Masonry Inspection:
 - 1. Masonry inspection services will be provided during the following construction activities:
 - a. Cost of masonry inspection services will be paid by Owner.
 - b. During laying of units:
 - 1) During the first day of the masonry construction, inspect proportions of site prepared mortar, construction of mortar joints, location of all reinforcing and connectors, size and location of structural elements, type, size and location of anchors, protection of masonry during cold weather.
 - 2) Inspection to be continuous the first full day of masonry construction which requires special inspection.
 - a) Thereafter, a minimum of 3 HRS every third day of construction until the concrete masonry work is complete.
 - 3) Inspection while laying masonry units may be made concurrently with other inspection duties provided all inspection duties are adequately performed.
 - 4) When deficiencies are found, additional inspection shall be provided as required until deficiencies have been corrected.
 - 5) If masonry crews change, an additional full day of inspection is required during the first day the new crew is on-site.
 - c. Placement of reinforcing steel:
 - 1) Verification of all reinforcing including size, grade, lap lengths, and type.
 - 2) Inspection may be periodic as required to verify all reinforcing.
 - 3) Inspector to be present during the concrete pour in which any dowels connecting concrete to masonry are cast.
 - a) Inspector to verify proper location of dowels.
 - d. Prior to each grouting operation, verify that grout space is clean, reinforcing is clean and connectors are properly placed, proportions of site-prepared grout are correct and mortar joints have been properly constructed.
 - 1) Inspection may be periodic as required to verify proper grout space.
 - e. Verify compliance with Building Code and Specifications continuously during all grouting operations.

- f. Provide special inspection in accordance with the MSJC Specification Level B Quality Assurance including observation of masonry work for conformance to the Contract Documents:
 - 1) Provide inspection reports to the Engineer, Building Official and Owner.
 - a) Notify Contractor of discrepancies for correction.
 - b) Notify Engineer, Building Official and Owner, in writing, when discrepancies have been satisfactorily corrected.
 - 2) Submit final signed report stating that work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the Contract Documents and the applicable workmanship provisions of the Building Code.

3.4 CLEANING

- A. Clean concrete masonry as the wall is being constructed using fiber brushes, wooden paddles and scrapers.
 - 1. Do not use metal tools or wire brushes.
 - 2. No acid-based cleaning solutions shall be used unless approved in writing by Engineer.
- B. Ground-face Masonry Units:
 - 1. Maintain walls clean during installation; remove all mortar splatters immediately using soft damp rag.
 - 2. Do not allow excess mortar to harden on faces.
 - 3. Wipe face of units often with sponge and clean water.
 - 4. No acid based cleaning solutions shall be used unless approved in writing by the Engineer.
 - 5. Refer to unit manufacturer's printed cleaning recommendations.
- C. Remove dirt and stains in accordance NCMA TEK 8-2A.
- D. Remove primary efflorescence in accordance with NCMA TEK 8-3A.
- E. After wall construction has been completed, completely clean wall using detergent recommended by ground-face unit manufacturer.
 - 1. See Specification Section 04 01 20.
- F. Apply manufacturer's recommended field-applied acrylic sealer to all ground-face masonry units.

END OF SECTION



DIVISION 05

METALS



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SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Cold-Formed Metal Framing in accordance with provisions of Contract Documents.
- B. Related Specification Section include but are not necessarily limited to:
 - 1. Division 01 – General Requirements
 - 2. 07 24 13 – Polymer-Based Exterior Insulation and Finish System
- C. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. ASTM International (ASTM):
 - 1. ASTM A1003 Standard Specification for Steel Sheet, Carbon, Metallic- and – Nonmetallic-Coated for Cold-Formed Framing Members.
 - 2. ASTM C1007 Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
- B. American Iron and Steel Institute (AISI):
 - 1. AISI S200 Series North American Standards for Cold-Formed Steel Framing.
- C. Provide Cold-Formed Metal Framing engineered to support dead, live, and lateral (wind or seismic) loads indicated.
 - 1. Comply with Section 01 35 73, Delegated Design Procedures,
 - 2. Include headers and reinforcing members around openings.
 - 3. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.
 - 4. Design cold-formed metal framing to accommodate building drift.

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each type of material and accessory.
- B. Shop Drawings:
 - 1. Complete building elevations defining framing member sizes, locations, and connection details.
 - a. Show openings, edges and support conditions field verified and coordinated with respect to location, physical requirements of items to be installed in or on exterior wall system.
- C. Project Information:
 - 1. Structural calculations for Cold Formed Metal Framing indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
 - a. Submit concurrent with Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cold-Formed Metal Framing:
 - 1. Base:
 - a. ClarkDietrich Building Systems

- 2. Optional:
 - a. Telling Industries
 - b. California Expanded Metal Products Co.
 - c. Custom Stud Inc.
 - d. Marino\WARE
 - e. MBA Metal Framing
 - f. MRI Steel Framing LLC
 - g. The Steel Network
- B. Galvanizing Repair Coating:
 - 1. Base:
 - a. Tnemec
 - 2. Optional:
 - a. ZRC Worldwide
 - b. Sherwin Williams

2.2 DESIGN CRITERIA

- A. Design Cold-Formed Metal Framing to satisfy requirements of applicable building codes as locally amended, but not less than loads shown in contract documents.
 - 1. Design Exterior Soffits similarly.
 - 2. Include anticipated dead and live with lateral, wind or seismic, loads where details indicate cladding, soffits or equipment weights are carried by stud wall system.
- B. Limit lateral deflection of stud wall system due to wind or seismic as follows:

Maximum Allowable Deflection	
Exterior Finish Material	Deflection Limit
Marble, Granite and other Stone Veneers	L/720
Brick and Concrete Masonry Veneers	L/600
Portland Cement Plaster (Stucco)	L/360
Manufactured Stone Veneer, Adhered Stone Veneer, Thin Brick, Tile and similar Mortar-Set finishes.	L/360
Metal Panels, Curtain Walls, and other flexible wall finishes.	L/240

- C. Select stud gauge and spacing as required for strength and to limit deflection due to applied loads.
 - 1. Utilize properties of metal stud only.
 - 2. Do not include contributions provided by wallboard or sheathing.
 - 3. Design connections such that anticipated structural movements will not adversely affect system or cladding supported by system
 - a. Allow for vertical beam deflections of span/600.
 - b. Allow for lateral interstory drift of story height/400.
 - 4. Design framing system to resist gravity loads and wind uplift at soffits.

2.3 MATERIALS

- A. Exterior Studs:
 - 1. 33 ksi 227 MPA steel studs, runner channels and track, bracing, and accessories.
 - a. Revise thickness and minimum requirements if 50 ksi 345 MPa steel is used.
 - 2. Coatings:
 - a. G60 Z180 galvanized
 - b. A60 ZF180, AZ50 AZ150, or GF30 ZGF90 EQ coatings.
 - 3. Stud depth:

- a. As indicated on Drawings.
- 4. Span:
 - a. As indicated on Drawings.
- 5. Stud spacing:
 - a. Use closer spacing as needed to satisfy load deflection criteria.
 - b. 12 inches 300 mm OC minimum.
 - c. 16 inches 400 mm OC maximum.
- 6. Stud, runner, and track thickness:
 - a. Minimum: 43 mils (18 GA) 1.09 mm.
 - b. Increase member thickness where needed to satisfy loading and deflection criteria.
- 7. Deep-leg runner flange:
 - a. Minimum: 2 inches 50 mm.
- 8. Headers:
 - a. C-shapes used to form header beams
 - b. Web depths and stiffened flanges as required.
 - c. Thickness: As determined by engineering calculations for specific opening.
- 9. Runner fasteners:
 - a. Power driven fasteners.
 - b. Minimum 190 pound (86 kg) shear and bearing.
- B. Galvanizing Repair Coating:
 - 1. Tnemec Series 94-H20 Hydro-Zinc.
 - 2. ZRC Worldwide, Galvilite 221.
 - 3. Sherwin Williams Zinc Clad III HS 100.
- C. Wood Sheathing:
 - 1. See Section 06 10 00.
- D. Gypsum Sheathing:
 - 1. See Section 06 10 00.
- E. Exterior Joint Sealants:
 - 1. See Section 07 92 00.
- F. Metal Blocking:
 - 1. C-shaped modified track runners.
 - a. Roll-form from corrosion-resistant galvanized steel.
 - b. Conform to ASTM C645.
 - 2. Galvanized: ASTM A653, G40.
 - 3. Backing height: 6 inches 150 mm minimum.
 - 4. Flange width: 1-1/4 inches 32 mm minimum.
 - 5. Thickness: 43 mil (18 GA) 1.09 mm minimum.
 - 6. Base product: Notched Track by Clark Dietrich.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate for suitability to accept work.
- B. Start of work constitutes acceptance of substrate and responsibility for performance.

3.2 ERECTION

- A. Studs and Runners:
 - 1. Align outside deep leg runner track accurately according to exterior wall layout.
 - 2. Fasten 12 inches (300 mm) OC, or as needed to satisfy design criteria.
 - 3. Position studs vertically in inside deep leg runners at required spacing.

4. Install minimum of two (2) studs each side of openings; use more if required to meet loadings.
 5. Anchorage:
 - a. Top:
 - 1) Allow 3/4 inches 19 mm clearance between top of inside deep leg runner and outside deep leg runner.
 - 2) Do not fasten inside deep leg runner to outside deep leg runner.
 - 3) Fasten studs to inside deep leg runner.
 - b. Bottom:
 - 1) Anchor each stud at bottom to runners with two, 3/8 inches 9.5 mm minimum, type S-12 pan head screws.
 6. Where stud design is outside edge of floor slab, provide galvanized connectors designed for loading requirements and allow individual floor movement without affecting integrity of stud system.
 7. Shop weld assemblies as required to meet design requirements.
 8. Touch-up burned off or abraded galvanizing with galvanizing repair coating.
- B. Openings:
1. Install header, jamb, and sill framing system per approved engineering documents
- C. Coordinate installation of wall blocking used to support wall-supported items with installation of Cold-Formed Metal Framing.

3.3 PROTECTION

- A. Protect erected wall and openings with temporary covers until finish, roofing, flashing, and windows are installed.

END OF SECTION

SECTION 05 50 00
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 Specification Sections.
 2. Design of all temporary bracing not indicated on Drawings.
 3. Design of systems and components, including but not limited to:
 - a. Landings.
 - b. Modular framing system.
- B. Related Specification Sections include but are not necessarily limited to:
1. Section 03 15 19 - Anchorage to Concrete.
 2. Section 03 31 30 - Concrete, Materials and Proportioning.
 3. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Aluminum Association (AA):
 - a. ADM 1, Aluminum Design Manual.
 2. American Association of State Highway and Transportation Officials (AASHTO):
 - a. HB, Standard Specifications for Highway Bridges.
 3. American Institute of Steel Construction (AISC):
 - a. 325, Manual of Steel Construction.
 - b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
 4. The American Ladder Institute (ALI):
 - a. A14.3, Ladders - Fixed - Safety Requirements.
 5. American Society of Civil Engineers (ASCE):
 - a. 7, Minimum Design Loads for Buildings and Other Structures.
 6. ASTM International (ASTM):
 - a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - b. A36, Standard Specification for Carbon Structural Steel.
 - c. A47, Standard Specification for Ferritic Malleable Iron Castings.
 - d. A48, Standard Specification for Gray Iron Castings.
 - e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
 - g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - i. A197, Standard Specification for Cupola Malleable Iron.
 - j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - k. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

- m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - n. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - o. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - p. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - q. A536, Standard Specification for Ductile Iron Castings.
 - r. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
 - s. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
 - w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 - y. A992, Standard Specification for Steel for Structural Shapes.
 - z. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - aa. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.
 - cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
 - hh. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - ii. F467, Standard Specification for Nonferrous Nuts for General Use.
 - jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
 - kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - ll. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
 - mm. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
 - nn. F1789, Standard Terminology for F16 Mechanical Fasteners.
 - oo. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
7. American Welding Society (AWS):
 - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. D1.1, Structural Welding Code - Steel.
 - c. D1.2, Structural Welding Code - Aluminum.
 - d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
 8. National Association of Architectural Metal Manufacturers (NAAMM):

- a. AMP 510, Metal Stairs Manual.
- b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
- c. MBG 531, Metal Bar Grating Manual.
- 9. NACE International (NACE).
- 10. Nickel Development Institute (NiDI):
 - a. Publication 11 007, Guidelines for the welded fabrication of nickel-containing stainless steels for corrosion resistant services.
- 11. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- 12. Research Council on Structural Connections (RCSC):
 - a. Specification for Structural Joints Using High-Strength Bolts.
- B. Qualifications:
 - 1. Qualify welding procedures and welding operators in accordance with AWS.
 - 2. Fabricator shall have minimum of 10 years of experience in fabrication of metal items specified.
 - 3. Engineer for contractor-designed systems and components: Professional structural engineer licensed in the State of Idaho.
 - 4. NACE certified inspector shall have minimum of two years of experience performing inspections as indicated.
 - a. Have a current Level III coating inspector certification.

1.3 DEFINITIONS

- A. Fasteners: As defined in ASTM F1789.
- B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 oz of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- C. Hardware: As defined in ASTM A153/A153M.
- D. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Qualifications:
 - a. NACE inspector qualifications.
 - 2. Fabrication and/or layout drawings and details:
 - a. Submit drawings for all fabrications and assemblies.
 - 1) Include erection drawings, plans, sections, details and connection details.
 - b. Identify materials of construction, shop coatings and third party accessories.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Provide manufacturer's standard allowable load tables for the following:
 - 1) Grating and checkered plate.
 - 2) Castings, trench covers and accessories.
 - 3) Modular framing systems.
 - 4. Contractor designed systems and components:
 - a. Certification that manufactured units meet all design loads specified.
 - b. Shop Drawings and engineering design calculations:
 - 1) Indicate design live loads.

- 2) Sealed by a licensed professional engineer, registered in the State of Idaho.
- 3) Engineer will review for general compliance with Contract Documents.
- c. Contractor designed systems and components include the following:
 - 1) Grating systems.

B. Informational Submittals:

1. Certification of welders and welding processes.
 - a. Indicate compliance with AWS.
2. NACE certification of surface preparation.
3. NACE certification of paint application.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and handle fabrications to avoid damage.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Abrasive stair nosings (embedded in concrete stairs):
 - a. American Safety Tread.
 - b. Balco.
 2. Headed studs and deformed bar anchors:
 - a. Nelson Stud Welding Div., TRW Inc.
 - b. Stud Welding Products, Inc.
 3. Mechanical anchor bolts:
 - a. See Section 03 15 19.
 4. Epoxy adhesive anchor bolts:
 - a. See Section 03 15 19.
 5. Concrete screw anchors:
 - a. See Section 03 15 19.
 6. Castings, trench covers and accessories:
 - a. Neenah Foundry Co.
 - b. Deeter Foundry Co.
 - c. Barry Craft Construction Casting Co.
 - d. McKinley Iron Works.
 7. Aluminum ladders:
 - a. Any manufacturer capable of meeting the requirements of this Specification Section.
 8. Galvanizing repair paint:
 - a. Clearco Products Co., Inc.
 - b. ZRC Products.
 9. Modular framing system:
 - a. Unistrut Building Systems.
 - b. B-Line Systems.
 - c. Kindorf.
 - d. Superstrut.
 10. Ladder safety extension post:
 - a. Bilco.

2.2 MATERIALS

- A. Steel:
 1. Structural:

- a. W-shapes and WT-shapes: ASTM A992, Grade 50.
 - b. All other plates and rolled sections: ASTM A36.
 2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
 3. Structural tubing:
 - a. ASTM A500, Grade B (46 ksi minimum yield).
 4. Bolts, high strength:
 - a. ASTM F3125, Grade A325.
 - b. Galvanized, ASTM A153/A153M.
 5. Nuts, high strength:
 - a. ASTM A563.
 6. Washers (hardened):
 - a. ASTM F436.
 - b. Provide two (2) washers with all bolts.
 7. Bolts and nuts (unfinished):
 - a. ASTM A307, Grade A.
 - b. Galvanized, ASTM A153/A153M.
 8. Welding electrodes: AWS D1.1, E70 Series.
 9. Steel forgings: ASTM A668.
- B. Iron:
1. Ductile iron: ASTM A536.
 2. Gray cast iron: ASTM A48 (minimum 30,000 psi tensile strength).
 3. Malleable iron: ASTM A47, ASTM A197.
- C. Stainless Steel:
1. Stainless steel in welded applications: Low carbon 'L' type.
 2. Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.
 - a. Bars, shapes: ASTM A276, Type 304.
 - b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
 - c. Strip, plate and flat bars: ASTM A666, Type 304 or 316.
 - d. Bolts and nuts: ASTM F593, Type 304 or 316.
 3. Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.
 - a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
 4. Welding electrodes: In accordance with AWS for metal alloy being welded.
- D. Aluminum:
1. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
 - a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
 - b. Weir plates, baffles and deflector plates, ASTM B209.
 2. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
 - a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
 3. ASTM B26 for castings.
 4. ASTM F468, alloy 2024 T4 for bolts.
 5. ASTM F467, alloy 2024 T4 for nuts.
 6. 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. Embedded Anchor Bolts:
1. See Specification Section 03 15 19.
- G. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
1. See Specification Section 03 15 19.
- H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.

- I. Deformed Bar Anchors: ASTM A1064 with a minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.
- J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to be galvanized.
- K. Galvanizing Repair Paint:
 - 1. High zinc dust content paint for regalvanizing welds and abrasions.
 - 2. ASTM A780.
 - 3. Zinc content: Minimum 92% in dry film.
 - 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."
- L. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.3 MANUFACTURED UNITS

- A. Ladders:
- B. 4 Bollards:
 - 1. 8 inches diameter extra strength steel pipe, ASTM A53.
 - a. Galvanized.
 - b. See Specification Section 09 96 00 for painting requirements.
- C. Aluminum Grating:
 - 1. NAAMM MBG 531.
 - 2. Minimum depth: 1-1/2 inches.
 - 3. Minimum rectangular bearing bar size:
 - a. 3/16 inches thick.
 - b. Maximum 1-3/16 inches on-center spacing.
 - 4. Minimum I-bar flange width: 1/4 inches.
 - 5. Design live load:
 - a. 100 psf, uniform load.
 - b. 300 pounds concentrated load on 4 inches square area.
 - c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
 - d. Maximum deflection: 1/300 of span under a superimposed live load of 50 psf.
 - 6. Cross bars:
 - a. Welded, swaged or pressure locked to bearing bars.
 - b. Maximum 4 inches on-center spacing.
 - 7. Top edges of bars: Grooved or serrated.
 - 8. Removable grating sections: Not wider than 3 feet and not more than 100 pounds.
 - 9. Standard mill finish.
 - 10. Ends and perimeter edges: Banded.
 - 11. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 inches high toe plate.
 - 12. Provide openings at joints between individual grating sections.
 - 13. Clips and bolts: Stainless steel.
 - 14. Seat angles: Aluminum.
 - 15. At Contractor's option, aluminum plank type grating with skid-resistant surface may be used.
 - a. Grating to have a minimum 35% up to a maximum of 45% open area and meet the design loads and deflection specified in this Specification Section.
- D. Heavy-Duty Castings, Trench Covers, and Accessories:
 - 1. Prefabricated, cast iron ASTM A48 or ductile iron ASTM A536.
 - 2. Design load: AASHTO HS-20 wheel loading for indicated span.
 - 3. Machine horizontal mating surfaces.
- E. Loose Lintels:

1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.
 2. Hot-dip galvanized per ASTM A123/A123M.
- F. Modular Framing System:
1. Materials:
 - a. Steel: ASTM A1011, carbon steel, Grade 33.
 - 1) Hot-dipped galvanized, ASTM A123 or ASTM A153.
 - b. Aluminum: ASTM B221 or ASTM B209.
 - c. Stainless steel: ASTM A666.
 2. Channels and inserts:
 - a. Steel or stainless steel: Minimum 12 GA.
 - b. Aluminum: Minimum 0.080 inches.
 - c. Channels to have one side with a continuous slot with in-turned lips.
 - 1) Width: 1-5/8 inches.
 - 2) Depth and configuration as necessary for loading conditions.
 3. Fittings: Same material as system major components.
 4. Fasteners:
 - a. Nuts: Toothed grooves in top of nuts to engage the in-turned lips of channel.
 - b. Bolts: Hex-head cap screws.
 - c. Same material as system major components.
 5. End caps:
 - a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 feet or less above the floor or platform.
 - a) Plastic for all exposed ends 7 feet or more above floor or platform.
 - b) Plastic or metallic for all other exposed ends.
 6. Provide dissimilar materials protection in accordance with Specification Section 09 96 00.
 7. Repair all cut ends or otherwise damaged areas of galvanized steel in accordance with ASTM A780.

2.4 FABRICATION

- A. Verify field conditions and dimensions prior to fabrication.
- B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
 1. Grind smooth all rough welds and sharp edges.
 - a. Round all corners to approximately 1/32 - 1/16 inches nominal radius.
- C. Provide drilled or punched holes with smooth edges.
 1. Punch or drill for field connections and for attachment of work by other trades.
- D. Weld Shop Connections:
 1. Welds to be continuous fillet type unless indicated otherwise.
 2. Full penetration butt weld at bends in stair stringers and ladder side rails.
 3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
 4. Weld aluminum in accordance with AWS D1.2.
 5. Weld stainless steel in accordance with AWS D1.6.
 - a. Treat all welded areas in accordance with ASTM A380.
 6. All headed studs to be welded using automatically timed stud welding equipment.
 7. Grind smooth welds that will be exposed.
- E. Passivate stainless steel items and stainless steel welds after they have been ground smooth.
 1. ASTM A380.
- F. Conceal fastenings where practicable.
- G. Fabricate work in shop in as large assemblies as is practicable.
- H. Tolerances:
 1. Rolling:

- a. ASTM A6.
 - b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
2. Fabrication tolerance:
- a. Member length:
 - 1) Both ends finished for contact bearing: 1/32 inches.
 - 2) Framed members:
 - a) 30 feet or less: 1/16 inches.
 - b) Over 30 feet: 1/8 inches.
 - b. Member straightness:
 - 1) Compression members: 1/1000 of axial length between points laterally supported.
 - 2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
 - c. Specified member camber (except compression members):
 - 1) 50 feet or less: -0/+1/2 inches.
 - 2) Over 50 feet: -0/+1/2 inches (+1/8 inches per 10 feet over 50 feet).
 - 3) Members received from mill with 75% of specified camber require no further cambering.
 - 4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
 - 5) Camber shall be measured in fabrication shop in unstressed condition.
 - d. At bolted splices, depth deviation shall be taken up by filler plates.
 - 1) At welded joints, adjust weld profile to conform to variation in depth.
 - 2) Slope weld surface per AWS requirements.
 - e. Finished members shall be free from twists, bends and open joints.
 - 1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.
- I. Fabricate grating, checkered plate, stairs, ladders and accessories using aluminum unless shown otherwise on Drawings.
- 1. Finish:
 - a. Mill, unless noted otherwise.
 - b. Coat surfaces in contact with dissimilar materials.
 - 1) See Specification Section 09 96 00.
- J. Fabricate grating in accordance with NAAMM MBG 531.
- 1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 inches.
 - 2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 inches.
 - a. Tolerance: NAAMM MBG 531.
 - 3. Removable sections: Not wider than 3 feet and not heavier than 100 pounds.
 - 4. Ends and perimeter edges: Banded, with alternate bearing bars welded to band.
 - a. Provide full depth banding unless noted otherwise.
 - b. Banding at trenches and sumps to be 1/4 inches less than grating depth to allow for drainage.
 - 5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 inches high toe plate.
 - 6. Provide joints at openings between individual grating sections.
 - 7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.
- K. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.
- 1. Workmanship: Class 2 unless noted otherwise.
- L. See Specification Section 09 96 00 for preparation and painting of ferrous metals and other surfaces.

2.5 SOURCE QUALITY CONTROL

- A. Surface Preparation:
 - 1. Refer to Specification Section 09 96 00 for surface preparation requirements.
 - 2. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied coatings.
 - a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
 - b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.
- B. Shop Applied Coating Application:
 - 1. Refer to Specification Section 09 96 00 for coating requirements.
 - 2. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of coatings.
 - 3. Application of coatings shall be observed and certified by NACE certified coatings inspector.
- C. Shop Inspection and Testing:
 - 1. Owner will employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents.
 - 2. 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.
 - 3. Independent testing agency shall have a minimum of five years performing similar work and shall be subject to Owner's approval.
- D. Responsibilities of Testing Agency:
 - 1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
 - a. Visually inspect all welds.
 - b. In addition to visual inspection, test 50% of full penetration welds and 20% of fillet welds with liquid dye penetrant or mag particle.
 - c. Test 20% of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
 - 2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
 - a. Verify direct tension indicator gaps, if applicable.
 - 3. Inspect structural steel which has been erected.
 - 4. Inspect stud welding in accordance with AWS Code.
 - 5. Prepare and submit inspection and test reports to Engineer.
 - a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide items to be built into other construction in time to allow their installation.
 - 1. If such items are not provided in time for installation, cut in and install.
- B. Prior to installation, inspect and verify condition of substrate.
- C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
 - 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

- A. Set metal work level, true to line, plumb.
 - 1. Shim and grout as necessary.
- B. Contractor is solely responsible for safety.

1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
 2. 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 or rigid connections are installed.
 3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
 4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.
- C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
1. Plumb, align, and set structural steel members to specified tolerances.
 2. 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.
 3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
 4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
 - a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
 5. Remove and dispose of all temporary work and facilities off-site.
- D. 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.
1. Report defects in work-in-place which may influence satisfactory completion of the work.
 2. Absence of such notification will be construed as acceptance of work-in-place.
- E. Field Measurement:
1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
 2. Contractor responsible for the accurate fit of the work.
- F. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
1. Use surveyor's level.
 2. Notify Engineer of any errors or deviations found by such checking.
- G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
- H. Erect plumb and level; introduce temporary bracing required to support erection loads.
- I. Use light drifting necessary to draw holes together.
1. Drifting to match unfair holes is not allowed.
- J. Welding:
1. Comply with AWS D1.1, AWS D1.2, and AWS D1.6 (as applicable for the material welded) and requirements of this Section's "Fabrications" Article in "Part 2 - Products".
 2. When joining two sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.
- K. Shore existing members when unbolting of common connections is required.

1. Use new bolts for rebolting connections.
- L. Clean stored material of all foreign matter accumulated prior to the completion of erection.
- M. Bolt Field Connections: Where practicable, conceal fastenings.
- N. Field Welding:
1. Follow AWS procedures.
 2. Grind welds smooth where field welding is required.
- O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
1. Replace entire section.
- P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.
- Q. Unless noted or specified otherwise:
1. Connect steel members to steel members with 3/4 inches diameter ASTM F3125, Grade A325 high strength bolts.
 2. Connect aluminum to aluminum with 3/4 inches diameter stainless bolts.
 3. Connect aluminum to structural steel using 3/4 inches diameter stainless steel bolts.
 - a. Provide dissimilar metals protection.
 4. Connect aluminum and steel members to concrete and masonry using stainless steel mechanical anchor bolts or adhesive anchor bolts unless shown otherwise.
 - a. Provide dissimilar materials protection.
 5. Provide washers for all bolted connections.
 6. Where exposed, bolts shall extend a maximum of 3/4 inches and a minimum of 1/2 inches above the top of installed nut.
 - a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.
- R. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
1. Provide hardened washers for all Grade A325 bolts.
 - a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.
- S. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.
- T. Secure metal to wood with lag screws of adequate size with appropriate washers.
- U. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
1. Provide full penetration welded splices where continuity is required.
- V. Provide each fabricated item complete with attachment devices as indicated or required to install.
- W. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.
- X. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
1. See Division 03 Specification Sections for non-shrink grout and anchorage.
 2. Set and anchor each base plate to proper line and elevation.
 - a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
 - 1) Wedges, shims and setting nuts to be of same metal as base plate they support.
 - 2) Tighten nuts on anchor bolts.
 - b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
 - 1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.

- c. Do not remove wedges or shims.
 - 1) Where they protrude, cut off flush with edge of base plate.
 - d. Fill sleeves around anchor bolts solid with non-shrink grout.
- Y. Tie anchor bolts in position to embedded reinforcing steel using wire.
 - 1. Tack welding prohibited.
 - a. Coat projecting bolt threads and nuts with heavy coat of clean grease.
 - 2. Anchor bolt location tolerance:
 - a. Per Section 03 15 19.
- Z. Install bollards as detailed on Drawings.
 - 1. Fill pipe with concrete and round off at top.
- AA. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
 - 1. Center stair nosings in stair width.
- BB. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
 - 1. Keep screw holes clean and ready to receive screws.
- CC. Attach grating to end and intermediate supports with grating saddle clips and bolts.
 - 1. Maximum spacing: 2 feet on-center with minimum of two per side.
 - 2. Attach individual units of aluminum grating together with clips at 2 feet on-center maximum with a minimum of two clips per side.
- DD. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.
- EE. Repair damaged galvanized surfaces in accordance with ASTM A780.
 - 1. Prepare damaged surfaces by abrasive blasting or power sanding.
 - 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Tolerances shall meet structural requirements for erecting items of structural nature.
- B. Tolerances (unless otherwise noted on the Drawings):
 - 1. Frame placement, after assembly and before welding or tightening.
 - a. Deviation from plumb, level and alignment: 1 inch 500, maximum.
 - b. Displacement of centerlines of columns: 1/2 inches maximum, each side of centerline location shown on Drawings.
- C. Owner Pays for Field Inspection and Testing:
 - 1. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with this Specification Section.
 - 2. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
 - 3. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

3.4 CLEANING

- A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.
- B. All stainless steel products in addition to Paragraph A. above:
 - 1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.

- C. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09 96 00.

END OF SECTION

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DIVISION 06

WOOD, PLASTICS, AND COMPOSITES



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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rough carpentry.
 - 2. Roof trusses.
 - a. Includes design.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 15 19 – Anchorage to Concrete
 - 4. Section 07 54 25 – Fully Adhered TPO Roofing
 - 5. Section 07 61 13 - Metal Roofing.
 - 6. Section 07 62 00 - Flashing and Sheet Metal.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Wood Council (AWC):
 - a. NDS, National Design Specification for Wood Construction.
 - 2. The Engineered Wood Association (APA):
 - a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.
 - b. U450, Storage and Handling of APA Trademarked Panels.
 - c. Y510, Plywood Design Specification.
 - 3. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. D153, Standard Test Methods for Specific Gravity of Pigments.
 - c. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
 - d. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - e. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. American Wood Protection Association (AWPA):
 - a. M2, Standard for Inspection of Preservative Treated for Industrial Use.
 - b. M3, Standard for the Quality Control of Preservative Treated Products for Industrial Use.
 - c. M4, Standard for the Care of Preservative-Treated Wood Products.
 - d. P5, Standard for Waterborne Preservatives.
 - e. U1, Use Category System: User Specification for Treated Wood.
 - 5. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
 - a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
 - 6. Environmental Protection Agency (EPA).
 - 7. FM Global (FM):
 - a. 1-49, Property Loss Prevention Data Sheets - Perimeter Flashing.
 - 8. National Institute of Standards and Technology (NIST):
 - a. PS 1, Quantitative NMR (Benzoic Acid).
 - b. PS-2, Performance Standard for Wood-Based Structural-Use Panels.

- c. PS 20, American Softwood Lumber Standard.
- 9. Truss Plate Institute Inc. (TPI):
 - a. 1, National Design Standard for Metal Plate Connected Wood Truss Construction.
 - b. HIB, Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses.
- 10. Underwriters Laboratories, Inc. (UL):
 - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
- 11. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
 - 1. Wood Treatment Plant: AWPA M3.
 - 2. Treated Wood Inspection: AWPA M2.
- C. Miscellaneous:
 - 1. Factory marking:
 - a. Lumber:
 - 1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.
 - 2) Marking may be omitted, as allowed by Building Code, if certificate of inspection is provided for each shipment.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication drawings of all fabricated items.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions for all products specified.
 - 4. Certifications:
 - a. Chemicals used in treatment process are registered with and approved by EPA.
 - b. Moisture content of material prior to treatment: 25 PCT maximum.
 - c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
 - 5. Documentation of treatment of treated material in accordance with standards referenced.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Wood trusses:
 - a. Provide the following:
 - 1) Design criteria, span, depth, slope and spacing of all trusses.
 - 2) Minimum bearing width required by lumber in truss.
 - 3) Design dead, live and wind loads and any concentrated loads and their point of application.
 - 4) Species, grade, size and dimension of all lumber.
 - 5) Connection details and plating requirements.
 - 6) Bracing details and location.
 - 7) Letter of certification signed and stamped by structural engineer registered in State of Idaho stating that wood trusses have been designed to meet the requirements of the Drawings, Specifications and the Building Code.
 - 8) Test results of connector plate lateral load evaluation to determine normal load values for design based on ultimate load and proportional limit value at 0.015 IN.
 - 9) Adjustments to metal connector plate and lumber design values.

1.4 DELIVERY AND STORAGE

- A. Delivery, storage and handling of untreated wood products:
 - 1. Lumber: As recommended by the grading agency indicated on the grade stamp.
 - 2. Plywood: APA U450.
- B. Delivery, storage, handling and disposal of treated wood products: AWWA M4.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Wood connectors:
 - a. Simpson Strong-Tie Company, Inc.
 - b. Or equal.
- B. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 MATERIALS

- A. General:
 - 1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
 - a. NIST PS 20.
 - b. Species:
 - 1) Treated material: As indicated in the appropriate AWWA standard.
 - a) Provide species of FRTM as necessary to achieve UL rating listed.
 - 2) Untreated material:
 - a) For nominal sizes up to and including 2 x 4: Hem Fir
 - b) For nominal sizes up to 2 IN thick and wider than 4 IN: Hem Fir
 - c. Grade:
 - 1) For nominal sizes up to and including 2 x 4: #1 and better.
 - 2) For nominal sizes up to 2 IN thick and wider than 4 IN: #1 and better.
 - 3) For nominal sizes greater than 3 IN thick and wider than 4 IN: Select Structural.
 - 2. Structural plywood:
 - a. NIST PS 1, NIST PS-2.
 - b. APA PRP-108, APA Y510.
 - c. Structural I Rated Sheathing:
 - 1) Exposure: EXT.
 - 2) Span rating: 32/16.
 - a) All plywood furnished for a single span rating to be the same thickness.
 - 3) Thickness: As indicated on Drawings.
 - 4) Touch sanded.
 - 3. Non-structural plywood:
 - a. NIST PS 1.
 - b. C-C plugged:
 - 1) Exposure: EXT.
 - 2) Thickness: As indicated on Drawings.
 - 3) Touch sanded.
- B. Preservative Treated Material:
 - 1. Moisture content:
 - a. Prior to treatment: 25 PCT.
 - b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
 - 1) Lumber: 19 PCT maximum.
 - 2) Plywood: 18 PCT maximum.

2. Preservative:
 - a. Waterborne: AWPA P5.
 - b. As indicated in the appropriate AWPA standard.
 3. Pressure-treat material in accordance with AWPA U1.
 4. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.
- C. Fire-Retardant Treated Material (FRTM):
1. Acceptable manufacturer:
 - a. Hoover Treated Wood Products, Inc.:
 - 1) Interior: "Pyro-Guard".
 - 2) Exterior: "Exterior Fire-X".
 2. Maximum moisture content:
 - a. Prior to treatment: 25 PCT.
 - b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
 - 1) Lumber: 19 PCT (KDAT).
 - 2) Plywood: 15 PCT (KD-15).
 3. Fire-retardant preservative:
 - a. Provide protection against decay:
 - 1) EPA registered for use as a wood preservative.
 - b. Shall not bleed-through or adversely affect bond of any finish.
 4. Pressure-treat material in accordance with AWPA U1.
 5. UL Classified:
 - a. FR-S, UL 723.
 - b. Exterior: No increase in classification when subjected to the Standard Rain Test, ASTM D2898.
 - c. Provide UL mark on each piece of FRTM.
 6. Maximum flame spread rating: 25, ASTM E84.
 7. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.
- D. Fasteners and Anchors:
1. Nails and screws:
 - a. Dry, non-corrosive exposure: Hot dipped galvanized meeting ASTM D153 or Type 304 stainless steel.
 - b. Wet, corrosive, marine, and/or below grade: Type 316 stainless steel.
 2. Adhesive anchors, expansion anchors, self-tapping concrete anchors, bolts, nuts, and washers: See Specification Section 03 15 19.
- E. Exterior Wall Sheathing:
- 1) Acceptable manufacturer:
 - 2) Georgia Pacific "DensGlass Gold Fireguard" exterior sheathing.
 2. Gypsum board sheathing: ASTM C1177/C1177M.
 3. Water and moisture-resistant treated gypsum core.
 4. Glass mat facing front and back.
 - a. Fire rated "TYPE X".
 5. Mold resistant: ASTM D3273.
 6. Class 'A' fire rated per UL 790.
 - 1) Flame spread 10, smoke developed 0 when tested in accordance with ASTM E84.
 - 2) Non-combustible when tested in accordance with ASTM E136.
 - 3) Thickness: 5/8 IN.
 - b. Fasteners: Type 304 self-tapping stainless steel screws, size as recommended by board manufacturers for heavy gage metal stud framing.
 7. Plywood sheathing:
 - a. Acceptable manufacturer:
 - 1) Hoover Treated Wood Products "Exterior Fire-X."

- b. Fire retardant treated plywood, UL classified FR-S, UL 723.
 - c. Thickness as shown on the Drawings.
 - d. Provide minimum B/C face with "B" face installed on the exterior side.
- F. Fascia Board and Miscellaneous Exterior Wood Trim: S4S clear redwood.
- G. Roof Trusses:
- 1. Lumber:
 - a. Species: Hem Fir.
 - b. Grade: #1 and better.
 - 2. Design trusses, connections, bracing, bridging and end bearings to resist loads shown on Drawings.
 - 3. Design and fabricate wood trusses to meet requirements of:
 - a. AF&PA NDS.
 - b. TPI 1.
 - c. Building Code.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify measurements, dimensions, and shop drawing details before proceeding.
- B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.
- C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

3.2 ERECTION AND INSTALLATION

- A. General:
 - 1. Provide preservative treated material for all wood used:
 - a. Outside building.
 - b. Below grade.
 - 2. Provide fire-retardant treated material for all wood used:
 - a. Inside building.
 - b. Exterior building walls.
 - c. Roof construction.
 - d. Parapet walls.
 - e. Roofing nailers.
- B. Attach work securely by anchoring and fastening as indicated or required to support applied loading.
 - 1. Anchor wood to concrete using adhesive or expansion anchors as specified in Specification Section 03 15 19.
 - a. Separate wood from direct contact to concrete with polyethylene foam gasket strip.
 - 1) Size: 1/4 IN by width of wood member.
 - 2) Owens Corning "SillSealR".
 - 2. Anchor wood to metal using bolts and nuts as specified in Specification Section 03 15 19.
 - 3. Provide flat washers under all bolt heads and nuts.
 - 4. Fasten plywood in accordance with APA recommendations.
 - 5. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
 - 6. Install fasteners without splitting of wood; predrill as required.
 - 7. Do not drive threaded friction type fasteners.
 - 8. Tighten bolts and lag screws at installation and retighten as required.
- C. Set work to required levels and lines, plumb, true.
 - 1. Shim as required.
 - 2. Cut and fit accurately.

- D. Provide wood grounds, nailers, or blocking where required for attachment of other work and surface applied items.
1. Form to shapes indicated or required.
 - a. FRTM lumber:
 - 1) Do not rip or mill.
 - 2) Cross-cutting and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
 - 3) Resurfacing, planing or fabrication of special shapes or profiles shall be done prior to treatment.
 - b. FRTM plywood:
 - 1) Cross-cutting, ripping and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
 - c. Light sanding of FRTM as permitted by UL to remove raised grain or prepare for finishing is allowable.
 - d. Field treat cuts and holes in preservative treated material in accordance with AWPA M4 and manufacturer's published recommendations.
 2. Grounds:
 - a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face of ground even with finish material.
 - b. Remove temporary grounds when no longer required.
 3. Install roofing nailers as necessary for attachment of flashing, curbs, fascia, coping, and related accessories:
 - a. Match height of nailers to insulation.
 - b. Anchor nailers to resist force of 300 PLF unless required otherwise by FM Global or roofing manufacturer.
 - 1) Metal decking attachment:
 - a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304 stainless steel hex head bolts with nuts and washers.
 - b) Countersink heads of bolts flush with top of nailer.
 - 2) Concrete decking attachment:
 - a) Attach base nailer to concrete roof deck using minimum 3/8 IN stainless steel adhesive anchors with minimum 3 IN embedment.
 - b) Countersink heads of bolts flush with top of nailer.
 - 3) Provide size and spacing of anchorage as required to meet loading criteria specified.
 - a) Fasten blocking for perimeter flashing in accordance with ANSI/SPRI ES-1 and FM Global 1-49.
 - c. Provide 1/2 IN vent spaces between lengths of nailers.
 - d. Install nailers over vapor retarder.
- E. When wood has been exposed to moisture allow to completely dry out prior to covering with additional wood or another material.
- F. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.
- G. Exterior Wall Sheathing Installation:
1. Install sheathing in accordance with manufacturer's installation guidelines and fastening requirements for loading requirements noted in the Contract Documents.
 2. Install sheathing with "gold side" out.
 3. Use maximum lengths possible.
 4. Do not tape joints between panels.
 5. If sheathing surface varies more than 1/8 IN from any one panel to an adjoining panel, remove the panels and reset.

- a. If the condition persists, remove the panels and correct sub framing as required so panels align properly.
 6. Drive fasteners to bear tight against and flush with surface of sheathing.
 - a. Do not countersink, fracture core or puncture facers with head of fastener.
- H. Wood Trusses:
1. Use care when handling so as not to subject trusses to excessive lateral bending.
 2. Erect trusses in accordance with recommendations of TPI HIB so as to be level, plumb and in correct location.
 3. Cutting and altering trusses is not permitted.
 4. Brace trusses sufficiently during construction to prevent toppling or dominoing prior to placing any load on trusses.
 5. Connect trusses to remainder of structure using wood connectors in accordance with details on drawings and manufacturers' recommendations.
 6. Provide bracing where required by truss designer.

END OF SECTION

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DIVISION 07

THERMAL AND MOISTURE PROTECTION



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SECTION 07 21 00
BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building insulation.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 04 22 00 - Concrete Masonry.
 - 4. Section 07 61 13 - Metal Roofing.
 - 5. Section 07 54 25 - Fully Adhered TPO Roofing.
 - 6.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C272/C272M, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
 - b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - c. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - d. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - e. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - f. D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - g. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. Building Materials Directory.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's recommendations on sealants, tapes and mastics.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certification from insulation manufacturer stating that insulation proposed is acceptable for intended use per the Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rigid extruded polystyrene board insulation:
 - a. Dow.
 - b. DiversiFoam Products.
 - c. Owens Corning.
 - d. Or equal.
 2. Rigid polyisocyanurate foam board insulation:
 - a. Dow.
 - b. Dyplast Products.
 - c. Hunter Panels.
 - d. Other manufacturers meeting the requirements of this Specification Section.
 3. Blanket or batt thermal insulation:
 - a. Owens Corning.
 - b. USG Corporation.
 - c. CertainTeed.
 - d. Or equal.
 4. Vapor retarder:
 - a. Raven Industries, Inc.
 - b. Reef Industries, Inc.
 - c. Fortifiber Building Systems Group, Inc by Henry Company.
 - d. Alumiseal.
 - e. Or equal.

2.2 MATERIALS

- A. General:
1. Foam plastic insulation used in buildings and structures shall comply with the requirements of the Building Code.
 - a. Surface burning characteristics: ASTM E84.
 - b. Flame spread index: Maximum 75.
 - c. Smoke developed: Maximum 450.
- B. Rigid Polystyrene Board Insulation:
1. Extruded: ASTM C578, Type IV.
 - a. Water vapor transmission: ASTM E96/E96M, 1.1 perm-IN maximum.
 - b. Water absorption: ASTM C272/C272M, 0.3 PCT maximum.
 - c. Thermal resistance: ASTM C518 at 75 DEGF mean temperature, 5.0/IN.
 2. Provide insulation designed for intended use.
 - a. Perimeter insulation and protection board.
 - 1) Similar to Dow "Styrofoam PERIMATE."
 - 2) Compressive strength: ASTM D1621, 30 PSI.
 - 3) Thickness:
 - a) Perimeter insulation: 2 IN.
 - b) Protection board: 1 IN.
 - 4) Edges:
 - a) Long edge: Shiplap.
 - b) Short edge: Square.
 - b. Cavity insulation:
 - 1) Similar to Dow "CAVITYMATE."
 - 2) Compressive strength: ASTM D1621, 15 PSI.
 - 3) Thickness: 2 IN.
 - 4) Edges: Square.

- C. Sealant and Mastic (for setting polystyrene and/or polyisocyanurate insulation board):
Manufacturer's recommended standard.
- D. Blanket or Batt Thermal Insulation:
 - 1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.
 - 2. Unfaced:
 - a. ASTM C665, Type 1.
 - 3. Minimum thickness as noted on Drawings.
- E. Vapor Retarder:
 - 1. Fire rated, reinforced, 3 ply, Class 1 material.
 - 2. Perm rating: Not exceeding 0.035 grains/HR-FT²-IN-Hg when determined in accordance with ASTM E96/E96M.
 - 3. Griffolyn "TX-1200FR."
- F. Vapor Retarder Tape: As recommended by vapor retarder manufacturer.
- G. Sound Control Insulation:
 - 1. Mineral wool batts.
 - a. ASTM C665, Type I.
 - b. UL listed when used in fire rated construction.
 - 2. Density: Minimum 2.5 PCF.
 - 3. Sound Reduction, ASTM C423.
 - a. Minimum NRC for 3 IN thick material: 1.05.
 - 4. Thickness: As noted on Drawings.
 - 5. Thermafiber "SAFB".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. General:
 - 1. Insulate full thickness over surfaces to be insulated.
 - 2. Fit tightly around obstructions, fill voids.
 - 3. Cover all penetrations (electrical junction boxes, switch boxes, piping, conduits, etc.) with insulation, taking care not to compromise the workings of the device.
 - 4. Fit butted joints of batt or blanket insulations tightly together.
 - 5. Apply single or double layer to achieve total thickness.
 - a. If double layer is provided, stagger all joints minimum 12 IN.
 - 6. Do not use broken or torn pieces of insulation.
 - 7. Install so that completed installation is vapor tight.
 - a. Seal all joints.
 - b. Seal to abutting materials to maintain vapor retarder integrity.
 - c. Provide manufacturer's recommended vapor retarder tape for use with faced batt insulation or separate vapor retarder.
 - 1) If vapor retarder tape fails to adhere to any surface, apply sprayed-on adhesive as recommended by tape manufacturer to promote adhesion.
 - d. Provide manufacturer's recommended solvent-free sealant compatible with insulation board for rigid board insulation.
 - 1) Tape is not acceptable for use with rigid board insulation.
 - 8. Provide insulation according to requirements set forth in Table C402.1.3 of the 2018 International Energy Conservation Code.
 - a. Climate Zone: Blaine County, Idaho (6B)
 - b. Insulation Entirely Above Roof Deck: R-30, continuous insulation (minimum).
 - c. Mass Walls, Above Grade: R-13.3, continuous insulation (minimum).

- C. Blanket or Batt Insulation using Separate Vapor Retarder Sheet in Exterior Stud Wall Systems:
 - 1. Verify that all piping, conduit, electrical box and other in-wall work is complete prior to installing insulation and vapor retarder.
 - 2. Install insulation friction fit between studs.
 - 3. Tightly butt ends.
 - 4. Install vapor retarder to warm side of building exterior wall.
 - a. Completely seal each wall area to surrounding construction.
 - 5. Install vapor retarder vertically.
 - a. Use widest practical sheet.
 - b. Install in continuous sheets, floor to structure above, without horizontal joints.
 - c. Fold flaps of vapor retarder over studs.
 - d. Tape flaps together continuously.
 - e. Tape bottom and top edges to structure continuously.
 - f. After installation of any additional conduit, boxes, piping or other items within wall system, repair all tears or penetrations of vapor retarder with vapor retarder tape prior to installation of gypsum board.

- D. Blanket or Batt Insulation with Facing:
 - 1. Set with facing to winter warm side of wall.
 - a. Install with facing flanges over the edge of the framing member.
 - b. Do not obstruct ventilation spaces.
 - 2. Fill all miscellaneous voids and where indicated on Drawings.
 - 3. Tape joints and ruptures in vapor retarder.
 - 4. Use vapor retarder tape and seal each area of insulation to surrounding construction to assure continuous vapor-tight installation.
 - 5. At Contractor's option, provide blanket or batt insulation without vapor retarder and provide separate vapor retarder as specified.

- E. Rigid Board Insulation in Cavity Walls:
 - 1. Do not proceed with installation until subsequent work which conceals insulation is ready to be performed.
 - 2. Set each piece of insulation flush with the abutting piece to eliminate ledges in the face of the insulation.
 - 3. Install mastic on face of concrete or masonry back-up in accordance with mastic and insulation manufacturer's recommendation.
 - 4. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly both ways.
 - 5. Set units firmly into mastic.
 - 6. Seal all horizontal and vertical joints with sealant recommended by insulation manufacturer.
 - 7. Do not use damaged insulation.

- F. Rigid Insulation at Perimeter Below Grade:
 - 1. Install insulation below grade on outside face of foundation walls.
 - a. Install in mastic with tight joints.
 - 2. Where footings are located below the design frost line, extend insulation down to the design frost line.
 - a. Where indicated on the Drawings, extend beyond the design frost line.
 - 3. Where footings are located at the design frost line, extend insulation down to top of footing or as indicated on Drawings.
 - 4. Protect insulation from damage and/or displacement during backfilling and/or pouring of floor slab.

- G. Sound Control Insulation:
 - 1. Install friction fit between studs.
 - 2. Do not obstruct ventilation spaces.
 - 3. Fill all miscellaneous voids unless noted otherwise on Drawings.

4. After installation of conduit, boxes, piping or other items within wall system, reposition displaced insulation and fill all voids.

3.2 FIELD QUALITY CONTROL

- A. Repair or replace damaged insulation and/or vapor retarder as directed by Engineer.

END OF SECTION

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SECTION 07 24 13
EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior insulation and finish system (EIFS).
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 04 22 00 - Concrete Masonry.
 - 4. Section 07 62 00 - Flashing and Sheet Metal.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - c. ANSI A42.3, Lathing and Furring for Portland Cement and Portland Cement-Lime Plastering, Exterior (STUCCO) and Interior.
- B. Qualifications:
 - 1. Applicator shall be licensed or approved in writing by manufacturer.
 - 2. Applicator shall have minimum 15 years' experience installing similar products on projects with similar scope.
 - 3. Applicator shall have successfully completed minimum of three (3) projects with similar scope during past three (3) years.
 - 4. Insulation board manufacturer shall be approved in writing by finish system manufacturer.
- C. Mock-Ups:
 - 1. Build in conjunction with work in Section 04 22 00.
 - 2. Mock-up shall constitute minimum standard of quality for actual construction.
 - a. Maintain mock-up during construction.
 - b. Protect mock-up from damage.
 - 3. If not acceptable, construct additional mock-up as required.
 - 4. Remove when directed by Engineer.
 - 5. Mock-up shall be constructed using stepped construction showing each operation involved in constructing the wall systems.
 - a. Include mock-up of all corners, joints, terminations and flashing details.
- D. Testing: The EIFS shall meet or exceed the following test results:
 - 1. Physical and Chemical Tests:
 - a. Absorption/Freeze/Thaw: 60 cycles, immersed in water at 69 DEG F for 4 days then cycled from 14 DEG F for 2 hours to 68 DEG F for hours; passed.
 - b. Slat Spray Resistance: ASTM B117, 300 hours ; passed.
 - c. Impact Testing: ASTM D2794; 170 IN-LBS.
 - d. Compressive Strength; ASTM C190; 700 psi.
 - e. Tensile Bond Strength: ASTM C203; 318 psi.
 - f. Mildew/Fungus Resistance: MIL SRD-810B Method 508; passed.
 - g. Abrasion Resistance: ASTM D968, 500 liters; passed.
 - h. Accelerated Weathering: ASTM G23, 2000 hours; passed.
 - 2. Structural Tests:
 - a. Impact Resistance: ASTM E695; 233 FT-LBS, L/133 deflection, no cracking.

- a. Full Scale Structural Tests: ASTM E330, 16 IN by 12 IN fastener spacing; 132 PSF negative and 170 PSF positive.
3. Fire Tests:
 - a. Insulation board and EIFS Coatings: ASSTM E84; flame spread less than 25.
 - b. Diversified Fire Test: High Intensity Modified ASTM E 108; passed.
 - c. Multi-Story Fire Test: CAN 4-S101-M82; passed.

1.3 DEFINITIONS

- A. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

1.4 SYSTEM DESCRIPTION

- A. Project Design Wind Load: See Section 01 81 33 - Wind and Seismic Design.
- B. Design system for high impact resistance.
- C. Application of wet material shall not take place during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are dry.
- D. The ambient air temperature on both sides of the wall shall be 40 DEG F or above at time of installation of wet materials, and shall remain so for at least 24 hours after installation is complete.
- E. Adjacent areas shall be protected from damage during the application of the EIFS.
- F. Installation shall be coordinated with other construction trades.
- G. Sufficient manpower and equipment shall be employed to ensure a continuous operation, free of cold joints, scaffold lines, texture variations, etc.

1.5 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Scaled details of all joints, corners, terminations and flashings.
 - 1) Minimum scale of details: 1-1/2 IN = 1 FT.
 - c. Manufacturer's installation instructions.
 3. Manufacturer recommendations for using metal lath specific to this Project.
- B. Samples:
 1. For initial color selection, provide manufacturer's full line color samples for Engineer's finish and color selection.
 2. After initial color selection, provide 12 x 12 IN sample of selected finish(es), texture(s), and color(s).
 3. One sample will remain on the site for use in comparing the approved appearance to that applied. It is the responsibility of the Contractor to ensure that the applied appearance is consistent with the sample and matches the existing finish and texture.
- C. Contract Closeout Information:
 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

2. Applicator qualifications.
3. Warranty.
4. Letter from EIFS manufacturer stating insulation to be used is acceptable as substrate for system specified.
 - a. Provide certification that insulation has achieved minimum aging requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in original containers bearing manufacturer's name, identification of contents, written application instructions, and health, hazard and safety data.

1.7 WARRANTY

- A. Provide manufacturer's standard limited materials warranty signed by the manufacturer.
 1. Warranty period shall be five (5) years.
- B. Provide five (5) year installation warranty signed by applicator against water intrusion, system or component loss of bond from substrate, peeling, flaking, chipping or cracking of surface as result of application defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Exterior insulation and finish system (EIFS):
 - a. Dryvit System, Inc.
 - b. STO Industries, Inc.
 - c. SYENERGY Wall Systems.
 - d. TEC, Inc.
 2. Polystyrene insulation board:
 - a. Any manufacturer acceptable to EIFS manufacturer.
 3. Sealant: See Section 07 62 00.
- B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 MATERIALS

- A. Primer/Adhesive: Water based acrylic material mixed with Portland cement as recommended by manufacturer for use as an adhesive and for fabric embedment.
- B. Portland Cement: ASTM C150, Type 1 or II.
- C. Sand:
 1. Dry bagged #40-45 sieve silica.
 2. Bulk dry clean sand conforming to ASTM C897.
- D. Rigid Polystyrene Board Insulation:
 1. Foamed, expanded:
 - a. ASTM C578, Type 1.
 2. Density:
 - a. Minimum 1.8 PCF at mechanically attached areas.
 3. Compressive strength:
 - a. 1.8 PCF density: 10 PSI minimum.
 4. Thermal resistance (value at 75 DEG F): 13.0 F-ft²-h/BTU (minimum).
 - a. Overall wall thermal resistance shall meet minimum required R-values indicated in 07 21 00 - Building Insulation.
 5. Dimensional tolerances (2 x 4 FT board size):
 - a. Edge trueness: Shall not deviate more than 1/32 IN/FT of length or width.
 - b. Thickness tolerance shall be plus/minus 1/16 IN.

6. Age (air dry) for minimum of six (6) weeks prior to use.
 7. Thickness: 3 IN.
 8. Maximum size board: 2 x 4 FT.
- E. Reinforcing Fabric:
1. Manufacturer's standard glass fiber field reinforcing fabric.
 2. Manufacturer is responsible for providing heavy-duty reinforcing fabric where required by project conditions.
- F. Finish Coat: Water based acrylic, factory-mixed coating, having integral color and texture.
- G. Admixtures:
1. Ultramesh: Treated, open weave, glass fiber mesh used to reinforce the base coat.
 2. Detail: Treated, open weave, glass fiber mesh used to coat over expanded polystyrene insulation.
- H. Water: Potable.
- I. Levelers and Groundcoats: As recommended by EIFS manufacturer.
- J. Additives: Rapid binders, anti-freeze, accelerators etc., are NOT ALLOWED.
- K. Sheathing: Acceptable to EIFS manufacturer.
- L. Sealant: Polyurethane based material approved by EIFS manufacturer.
- M. Metal Lath:
1. Diamond mesh 3/4 LB/SY minimum galvanized for use in installing system over unsound surfaces.
 2. Verify with system manufacturer.
- N. Fasteners for Mechanically Attached System:
1. 1/8 IN diameter washers, Wind-Lock ULP-302, approved by the EIFS manufacturer.
 2. Minimum NO. 10 masonry screws with yellow dichromate corrosion resistant coating, minimum 1 IN penetration into substrate.
- O. Sheet Metal Drip: See Section 07 62 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide metal lath over previously painted and/or other unsound surfaces or where indicated on Drawings or where required by EIFS manufacturer.
- C. Verify sheathing and accessories are complete and sound.
- D. At terminations, the insulation board edges shall be encapsulated by either casing beads or base coat.
- E. Insulation Board:
 1. The insulation board shall be mechanically fastened to the substrate using a minimum of 1 fastener for every eight (8) SQ FT of insulation board.
 2. The fasteners shall be installed so that the insulation board is pulled snug to the wall and is slightly dimpled by the washer. The face of the washer shall sit no more than 1/16 IN above or below the face of the insulation.
 3. At penetrations where control joints are not used, the insulation board shall be installed so the edges do not coincide with the corners of the opening.
 4. At control joints, cut a 1/2 IN wide by 3/4 IN deep groove in the insulation to accommodate the control joint.

- F. Reinforcing Mesh:
1. Ultramesh shall be installed over the entire face of the insulation board and anchored through the insulation board into the substrate. Pieces shall overlap a minimum of 2-1/2 IN and a maximum of 4 IN.
 2. Install the remaining fasteners on a 12 IN by 16 IN pattern. The face of the washer shall sit no more than 1/16 IN above or below the face of the insulation.
 3. The mesh shall lay flat with no tears, wrinkles, waves, or cuts.
- G. Accessories:
1. Control joints, corner reinforcement, and other trim accessories shall be properly located and fastened to the insulation board using nylon fasteners.
 2. At control joints, the trim shall be set into a neutral cure sealant such as Dow Corning 790, so that the gaps are completely sealed.
- H. Base Coat:
1. Mix the base coat in the following proportions as recommended by the EIFS manufacturer:
 - a. 35 LBS Starter
 - b. 94 LBS Portland Cement
 - c. 1 LBS Ultrafibers
 - d. 200 LBS sand.
- I. Finish Application:
1. The finish shall be applied to distinct wall surfaces in a continuous application.
 2. The finish shall be applied as required to match the existing finish.
- J. Sealant and Flashing:
1. Sealant and flashing shall be installed as soon as practical after completion of the EIFS installation.
 2. Temporary protection shall be provided until sealant and flashing is installed to prevent damage from water entry behind the EIFS.
 3. Install in accordance with sealant, flashing, and EIFS manufacturer's recommendations to obtain a weather tight system.
- K. Expansion joints shall be installed at the following locations:
1. Where expansion joints occur in the substrate or building.
 2. At EIFS terminations,
 3. Where substrate changes.
 4. Where significant structural movement is anticipated.
 5. According to manufacturer's recommendations.
- L. Control joints shall be located as recommended in ANSI A42.3 and as follows:
1. Monolithic wall areas shall not exceed 144 SQ FT.
 2. Dimensions between horizontal or vertical joints shall not exceed 12 FT.
 3. The length to width ratio of any area shall not exceed 2.5 to 1.
 4. At high stress areas such as corners of windows, doors, and other penetrations.
 5. To match pattern of existing joints.
 6. According to manufacturer's recommendations.
- M. Aesthetic joints in accordance with manufacturer's guidelines and as shown on Drawings.
- N. Seal all control, expansion and other joints in accordance with manufacturer's instruction.
- O. Outside corners shall be reinforced by wrapping mesh continuously around the corner and installing wire corner reinforcement or expanded flange corner beads over the mesh.
- P. Corners of minor openings, where it is not feasible to install control joints, shall be additionally reinforced using 9 IN by 12 IN "butterfly" strip mesh laid at a 45-degree angle to the corner. The insulation board shall be installed at these locations so that its joints do not coincide with the corners of the opening.

- Q. Cure material in accordance with system manufacturer's recommendations.
- R. Provide galvanized sheet metal drip at head of all exterior openings and at bottom of wall above grade.

3.2 PATCHING

- A. When the area to be repaired represents a large portion of a panel, saw cut and remove the entire panel from joint to joint, including the finish coat, basecoat and insulation board.
 - 1. Mask out the repair area to avoid splatter onto the adjacent undamaged area.
 - 2. Replace the EIFS as noted above.
- B. When the area to be repaired represents a small portion of a panel, repair as follows:
 - 1. Cut out and remove affected area using a power saw with a masonry cutting blade.
 - 2. Using a disk grinder, remove finish and 1/8-in. of base coat for a minimum of 4-in. around the damaged area. Be careful not to damage the mesh reinforcement.
 - 3. Cut a piece of insulation board to fit tightly into the damaged area and anchor in place.
 - 4. Mask out the repair area to avoid splatter onto the adjacent undamaged area.
 - 5. Apply the base course mixture over the insulation board and onto the overlap area approximately 1/8-in. Immediately install a layer of Ultramesh in the mixture such that it is fully embedded.
 - 6. Apply base coat as needed to bring level with the undamaged base coat.
 - 7. Strike, texture, and finish as noted above.

END OF SECTION

SECTION 07 26 00
UNDER SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Under slab vapor retarder.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
 - 2. ASTM International (ASTM):
 - a. E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - b. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Product data sheet on vapor retarder sheet and vapor retarder tape.
 - c. All accessories proposed for use.
 - d. Manufacturer's installation instructions.
- B. Samples:
 - 1. Provide two, 6 IN x 6 IN samples of vapor retarder material taped together using the vapor retarder tape proposed.
 - 2. Provide two samples of all accessories proposed for use.
- C. Informational Submittals: Manufacturer's recommendation on vapor retarder tape.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Vapor retarder:
 - a. Fortifiber Building Systems Group, Inc. by Henry Company.
 - b. Layfield Group, Ltd.
 - c. Raven Industries, Inc.
 - d. Reef Industries, Inc.
 - e. Stego Industries, LLC.
 - f. W.R. Meadows, Inc.
 - g. Or equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder:
 - 1. ASTM E1745, Class A.
 - 2. Thickness: Minimum 15 MIL.
 - 3. Water vapor permeance: 0.02 maximum.

2.3 ACCESSORIES

- A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor retarder system.
- B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Base material over which vapor retarder is to be installed shall be level, compacted and free of debris, foreign objects or other deleterious materials.
- B. Surfaces at perimeter and penetrations of vapor barrier shall be clean, smooth and free of sharp objects, fins or projections.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.
- B. Provide vapor retarder where indicated on the Drawings.
 - 1. Place continuous vapor retarder above granular fill subgrade material, unless noted otherwise.
- C. Lap minimum 6 IN and seal in accordance with ASTM E1643 and manufacturer's recommendations.
- D. Extend to extremities of area and seal to adjacent elements.
- E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

3.3 FIELD QUALITY CONTROL

- A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder membrane prior to and during pouring of concrete floor slab.
- B. Inspect vapor retarder immediately prior to placement of concrete.
 - 1. Patch all punctures, tears, holes, etc.
 - a. Patch small punctures with vapor retarder tape as allowed by ASTM E1643 and manufacturer's recommendations.
 - b. Repair larger damage with additional layer of vapor retarder.
 - 1) Lap repairs minimum 6 IN beyond extent of damage in all directions.
 - 2) Seal perimeter of patch with vapor retarder tape or as recommended by manufacturer.

END OF SECTION

SECTION 07 54 25
FULLY ADHERED TPO ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Fully Adhered TPO Roofing in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. Manufacturer authorized roofing installer.
- B. Component products made by single manufacturer or approved for use with warranted system.
- C. ASTM International (ASTM):
 - 1. ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 2. ASTM C1303 Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
 - 3. ASTM D6878 .
- D. American National Standards Institute (ANSI) / Single Ply Roofing Industry (SPRI):
 - 1. ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems
- E. National Roofing Contractors Association (NRCA):
 - 1. Roofing and Waterproofing Manual.
- F. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - 1. Architectural Sheet Metal Manual.
- G. Underwriters Laboratories (UL):
 - 1. UL 790, Standard for Tests for Fire Resistance of Roof Covering Materials.
- H. Concrete Moisture Vapor Testing:
 - 1. Coordinate maximum moisture allowed in concrete deck with roofing manufacturer.
 - 2. Test concrete decks for moisture.
 - 3. If moisture content exceeds manufacturer's recommendation, install moisture control system.
- I. Fire Resistance Rating:
 - 1. UL 790, Class A.
 - 2. Assembly in conformance with fireproofing as specified.
- J. Preinstallation Conference:
 - 1. See Section 01 31 19.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Roof layout showing insulation thicknesses and details.
 - 2. Indicate location of expansion joints, crickets, saddles, curbs, walkways, safety tiebacks, vents, drains and other penetrations.
 - 3. Indicate slope direction, slope amount, and key vertical elevation points.
 - 4. Profiles of flashing assemblies.
 - 5. Installation Drawings.

- B. Product Data:
 - 1. Manufacturer standard literature for vapor barrier, insulation, and roofing system components, including adhesives and accessories indicating compliance with specification requirements.
 - 2. Manufacturer standard literature for roof coping system indicating components and accessories including anchor plate configuration.
- C. Samples:
 - 1. Roofing manufacturer's facsimile of each sheet metal color for pre-selection.
 - 2. 3 inches x 5 inches 75 mm x 125 mm samples of roofing manufacturer's sheet metal color for final approval.
- D. Project Information:
 - 1. Minutes from Preinstallation Conference.
- E. Contract Closeout Information:
 - 1. Warranty.
 - 2. Maintenance Data:
 - a. See Section 01 78 23.

1.4 WARRANTY

- A. Fifteen (15) year warranty of weathertightness signed by roofing materials manufacturer.
 - 1. Warranty to include coverage for peak gusts of wind to:
 - a. 55 mph 80 KPH at 33 feet 10 M above ground.
 - 2. Warranty to include the entire system: membrane, flashings, adhesives, sealants, counterflashings, insulation, fasteners, fastener plates, fastener strips, hard rubber or metal edging, metal termination bars, sheet metal copings and edge metal, and other material authorized by manufacturer.
- B. Twenty (20) year warranty on 70 percent PVDF (Kynar 500) coatings on edge metal and copings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fully Adhered TPO Roofing:
 - 1. Base:
 - a. Carlisle SynTec
 - 2. Optional:
 - a. Firestone Building Products, Holcim Elevate
 - b. GAF
 - c. Johns Manville
- B. Sheathing:
 - 1. Base:
 - a. Georgia-Pacific.
 - 2. Optional:
 - a. Same as Membrane Manufacturer.
 - b. USG Corporation.
 - c. National Gypsum.
- C. Vapor Retarder (VR):
 - 1. Base:
 - a. Same as Membrane Manufacturer.
- D. Walkways and Pavers:
 - 1. Base:
 - a. Same as Membrane Manufacturer.

- E. Sheet Metal Coping and Edge Metal:
 - 1. Base:
 - a. Provided by manufacturer of roofing system.
- F. Other Materials:
 - 1. Manufacturers as noted.
- G. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

- A. Determine per Wind Load Design Guide for Low Sloped Flexible Membrane Roofing Systems published by SPRI.
- B. Design roof system and anchorage fastener type and spacing needed to resist uplift pressures including roof covering and metal edge securement to meet design loads and satisfy requirements of applicable building codes, local amendments, and ANSI/SPRI ES-1.
- C. Wind loads: Use the greater of the following:
 - 1. Wind pressures as required per local building code based on wind speed, exposure factor and importance factor noted in Structural Drawings.
 - 2. Wind pressures defined by Building Code as locally adopted and amended.
 - 3.
- D. Requirements applicable to designated warranty.
- E. Roof height and parapet height: As indicated.
- F. Static pressure of building interior: Less than 0.5 inches 12.7 mm H₂O (125 Pa) water.

2.3 MATERIALS

- A. Sheathing:
 - 1. Install over steel deck or existing roofing materials.
 - 2. Moisture resistant gypsum core with fiberglass mat and non-asphaltic surfacing.
 - 3. Minimum Thickness: 5/8 inches.
 - 4. Base Product: DensDeck Prime Roof Board by Georgia-Pacific.
- B. Vapor Retarder:
 - 1. Rubberized asphalt membrane adhered to polyethylene or polyolefin top sheet.
 - 2. 30 mil 0.76 mm thick, minimum.
 - 3. Vapor Permeance: Not exceeding 0.05 Perm 2.86 ng/s/m²/Pa.
 - 4. UV protected for 90 day exposure.
 - 5. Primer or adhesive as recommended for substrate by manufacturer.
 - 6. Base Product: Carlisle 725TR.
- C. Roof Insulation:
 - 1. Furnished by roofing manufacturer.
 - 2. UL listed for assembly indicated.
 - 3. Provide crickets and saddles as required.
 - 4. Polyisocyanurate (PISO) roof insulation:
 - a. Rigid, closed cell foam core bonded to heavy-duty glass fiber mat facers.
 - b. ASTM C1289 Type II, Class 1.
 - c. R-value: 5.6 per inch 1 per 25 mm in accordance with ASTM C1303, CAN/ULC S770.
 - d. Compressive strength: 25 psi 170 kPa minimum per ASTM D1621, Grade 3.
 - e. Dimensional stability: 2 percent maximum linear change in seven days per ASTM D2126.
 - f. Minimum insulation thickness:
 - 1) Areas where tapered insulation is indicated:
 - a) Minimum R-30 RSI-5.3 at roof drains.
 - b) Taper to provide slope of 1/4 inches per FT 1 mm per 48 mm.

- 2) Areas with uniform insulation thickness (sloped structures):
 - a) Minimum R-30 RSI-5.3 at roof drains.
- D. Cover Board:
1. Moisture resistant gypsum core with fiberglass mat and non-asphaltic surfacing.
 2. Minimum Thickness: 5/8 inches.
 3. Base Product: DensDeck Prime Roof Board by Georgia-Pacific.
- E. TPO Roofing Membrane:
1. Material: Thermoplastic Polyolefin (TPO) single-ply roofing membrane.
 - a. Fire Retardant.
 - b. Polyester fabric reinforced.
 2. Color: White.
 3. Thickness: 60 mil thick.
 4. Minimum Physical Properties:
 - a. Thickness over scrim: 15 mil 0.38 mm by ASTM D4637.
 - b. Tearing Strength: 55 pounds 24.9 kg MIN by ASTM D751.
 - c. Breaking Strength: 225 pounds 102 kg MIN by ASTM D751.
 - d. Heat Aging: retain 90 percent of original Breaking Strength and Elongation values.
 - e. Weather Resistance: 10,080 kJ/m2 by ASTM G155.
 5. Base Product: SureWeld by Carlisle SynTec.
- F. Membrane flashings, fasteners, adhesives, tapes, cements, and sealants:
1. Roofing manufacturer's standard.
- G. Edge Metal and Coping:
1. Roofing Manufacturer's pre-engineered, prefabricated system for termination of roofing membrane.
 2. Field fabricated components approved by roofing manufacturer for warranted system.
 3. Fasteners concealed from view.
 4. Concealed splice plates, with color matching snap-on covers.
 5. Anchor cleats:
 - a. Material: G90 galvanized steel.
 - b. Thickness: 20 GA.
 6. Snap-on cover:
 - a. Material: G90 Z275 galvanized steel.
 - b. Thickness:
 - 1) For dimensions less than 10 inches 250 mm: 24 GA 0.7 mm.
 - 2) For dimensions 10 to 24 inches 250 mm to 610 mm: 22 GA 0.85 mm.
 - c. Finish: 70 percent PVDF Kynar 500.
 - d. Color:
 - 1) To be selected from manufacturers standard colors by Architect.
 7. Wind Rating: Design for pressure indicated for balance of roof system.
 8. Coverage of these items to be included in roof system warranty.
 9. Comply with applicable standards.
 10. Roof Edge/Fascia:
 - a. Match profiles indicated.
 - b. Include accessories such as pre-fabricated inside and outside corners, Overflow and Downspout Scuppers, Edging Extensions, Fascia Sumps, and other items indicated.
 - c. Base: SecurEdge 2000 Fascia by Carlisle SynTec.
 11. Coping:
 - a. Match profiles indicated.
 - b. Include accessories such as pre-fabricated inside and outside corners (seamed), End Caps, Saddles, Tee's, Crosses, Transition Pieces and Radiused Copings, and other items indicated.
 - c. Base Product: SecurEdge 200 Coping by Carlisle SynTec.

- H. TPO Walkway Roll:
 - 1. Manufacturer's standard walkway roll stock, designed to protect TPO roof membrane.
 - a. Slip-resistant surface.
 - 2. Nominal Thickness: 160 mil 4 mm.
 - 3. Size: 34 inches x 50 feet 860 mm x 15.25 M roll.
 - 4. Secure to roof membrane by heat welding.
 - 5. Discontinue walkway at roof membrane seams.
 - 6. Color:
 - a. To be selected from manufacturers standard colors by Architect.
 - 7. Base Product: Sure-Weld Walkway Roll by Carlisle SynTec.
- I. Nailing Strips:
 - 1. As detailed and required.
- J. Pipe Flashings:
 - 1. Provide for each pipe penetration; include clamps, adhesive and sealants.
- K. Underlayment for Pavers:
 - 1. As recommended by roofing manufacturer.
- L. Adhesives, Cleaners, and Primers:
 - 1. As recommended by roofing manufacturer.
- M. Fire-Retardant Treated (FRT) Wood Blocking:
 - 1. See Section 06 10 00.
- N. Other Materials as required by manufacturer for complete system warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine entire area to be roofed for acceptability.
- B. Ensure substrate for insulation or roofing membrane is clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, and foreign materials.
- C. Correct unsatisfactory conditions.
- D. Commencement of roofing activities constitutes acceptance of all conditions affecting installation and roofing system performance.

3.2 INSTALLATION

- A. Sheathing:
 - 1. Install per UL requirements.
 - 2. Lay sheathing tightly butted and cut to fit around penetrations.
 - 3. Attach sheathing to deck in accordance with roofing manufacturer's recommendations.
- B. Vapor Retarder:
 - 1. Install in largest practical widths.
 - 2. Bond vapor retarder to substrate using approved adhesive.
 - 3. Install continuously.
 - a. Ensure surfaces to be taped are clean and dry.
 - b. Ensure that no discontinuities occur, including at seams, penetrations, and edge terminations.
 - c. Join sections of vapor retarder and lap seams in direction of water flow.
 - d. Continuously seal roof vapor retarder to wall air and moisture retarder.
 - 4. Seal around pipes, conduits, curbs, safety tie-backs, and other penetrations with pipe boots in accordance with manufacturer's instructions.

5. Maintain continuity of vapor retarder over expansion joints.
 6. Repair holes in vapor retarder with method and material recommended by manufacturer.
 7. Protect vapor retarder from damage until covered with insulation.
- C. Wood Nailers:
1. Design to resist a minimum of 200 pounds/LF in any direction per SPRI Test Method RE-1.
 2. Provide where indicated or required for proper securement of roofing system.
 3. Install top of blocking flush with top of insulation.
- D. Insulation:
1. Where required thickness of insulation is greater than 2 inches 50 mm: Install insulation in at least 2 layers.
 2. Stagger board joints in successive layers laterally and longitudinally.
 3. Butt joints tightly.
 4. Cut insulation neatly to fit around roof penetrations and projections.
 5. Secure insulation with approved adhesive.
- E. Membrane:
1. Unroll and position membrane without stretching.
 - a. Allow membrane to relax prior to bonding.
 2. Position sheets to accommodate contours of roof deck.
 3. Apply bonding adhesive in accordance with the manufacturer's instructions, to exposed underside of the membrane and the corresponding substrate area.
 4. Protect membrane from stains/discoloring caused by adhesives.
 5. Membrane Splices:
 - a. Hot air weld TPO membrane sheets using Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's hot air welding procedures.
 - b. Locate field splices away from low areas and drain sumps.
 - c. Shingle field splices to avoid bucking water.
 - d. Probe seams once the hot air welds have thoroughly cooled.
 - e. Repair seam deficiencies same day they are discovered.
 - f. Apply sealant of type recommended by membrane manufacturer on cut edges of reinforced membrane where scrim reinforcement is exposed after seam probing is complete.
 6. Secure membrane along the perimeter of each roof level, roof section, curb, skylight, penthouse, and other penetrations as recommended by membrane manufacturer.
 7. Flashing:
 - a. Follow manufacturer's typical flashing procedures for wall, curb, and penetration flashing including metal edging/coping and roof drain applications.
 - b. Flashing of parapets, curbs, expansion joints and other parts of roof must be performed using reinforced TPO membrane.
 - c. Manufacturer's standard, non-reinforced TPO membrane can be used for flashing pipe penetrations, sealant pockets, scuppers, as well as inside and outside corners when use of pre-fabricated accessories is not feasible.
 - d. Terminate base-of-wall flashings in accordance with manufacturer's approved details.
 - e. Pre-flashing at sheet metal parapet copings:
 - 1) Extend TPO membrane, flashing or both over top of parapet prior to capping with sheet metal.
 - f. Expansion Joints:
 - 1) Extend TPO membrane across roofing expansion joints.
 - 2) Include adequate slack in membrane to accommodate anticipated movement.
 8. Hot or Cold Weather Procedures:
 - a. Comply with manufacturer's instructions.

3.3 INSTALLATION - EDGE METAL AND COPING

- A. Sub-flash details with a layer of TPO membrane prior to installation of edge metal or coping system.
- B. Secure anchor cleat to blocking as recommended, using corrosion-resistant fasteners.
- C. Install splice plates and snap-on covers.

3.4 INSTALLATION – WALKWAYS

- A. Install walkways at traffic concentration points, such as roof hatches, access doors, rooftop ladders, or locations as indicated.
- B. Do not locate within 10 feet 3 M of roof edge.
- C. Clean surfaces to be bonded.
- D. Secure by heat welding as recommended by membrane manufacturer.

3.5 PROTECTION

- A. When completion of flashings and terminations is not achieved by end of workday, seal system to temporarily prevent water infiltration.
- B. Remove temporary water cutoffs prior to proceeding with Work.
- C. Remove and replace wet insulation.

3.6 SCHEDULE OF ROOF SYSTEMS

- A. Roof System 1 – Fully Adhered TPO over Steel Deck:
 - 1. Gypsum Sheathing.
 - 2. Vapor Retarder.
 - 3. Insulation.
 - 4. Cover Board.
 - 5. TPO Membrane.
- B. Roof System 2 – Fully Adhered TPO over Concrete Deck:
 - 1. Vapor Retarder.
 - 2. Insulation.
 - 3. Cover Board.
 - 4. TPO Membrane.
- C. Roof System 3 – Fully Adhered TPO over Concrete Deck at Precast Concrete Pavers:
 - 1. Vapor Retarder.
 - 2. XPS Insulation.
 - 3. Cover Board.
 - 4. TPO Membrane.

END OF SECTION

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SECTION 07 61 13

METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vapor retarder.
 - 2. Roof insulation.
 - 3. Ice dam membrane.
 - 4. Standing seam metal roofing.
 - 5. Prefinished gutters and downspouts.
 - 6. Soffit panels.
 - 7. Snow retention system.
 - 8. Sheet metal work required for roofing.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 06 10 00 - Rough Carpentry.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 621, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
 - b. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 2. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. A792/A792M, Standard Specification for Steel Sheet, 55 PCT Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - c. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - d. C209, Standard Test Methods for Cellulosic Fiber Insulating Board.
 - e. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - f. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - g. D1970/D1970M, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - h. D4833/D4833M, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - i. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
 - j. E1592, Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
 - k. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 - l. E1680, Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
 - m. E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

- n. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 3. FM Global (FM):
 - a. 4450, Approval Standard for Class 1 Insulated Steel Deck Roofs.
 - 4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Architectural Sheet Metal Manual.
 - 5. Underwriters Laboratories, Inc. (UL):
 - a. Building Materials Directory.
 - b. Fire Resistance Directory.
 - c. 580, Standard for Tests for Uplift Resistance of Roof Assemblies.
 - d. 790, Standard Test Methods for Fire Tests of Roof Coverings.
 - e. 1256, Standard for Fire Test of Roof Deck Constructions.
 - 6. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
- B. Qualifications:
- 1. Manufacturer shall have minimum of 10 years of experience in the production of structural standing seam metal roofing.
 - a. All structural components of the roof system shall be designed and sealed by registered professional structural engineer licensed in the State of Idaho.
 - 2. Installing contractor shall be licensed or approved in writing by manufacturer.
 - 3. Contractor and installer shall have minimum of seven years of experience in the installation of structural standing seam metal roof systems similar to system specified.
 - 4. Contractor and installer shall have successfully completed two projects of similar size, scope and complexity within past two years.
- C. Mock-Ups:
- 1. Prior to start of permanent roof construction construct mock-ups of roofing system.
 - a. Mock-ups shall be of sufficient size to properly display all components required by the roofing system.
 - b. Mock-ups shall be a minimum 5 FT x 5 FT in size.
 - c. Provide multiple mock-ups as required.
 - 2. Mock-ups shall incorporate all components, specified and/or required but not specified, needed for a complete water and airtight roofing system.
 - a. Components include, but are not limited to:
 - 1) Vapor retarder, thermal barrier sheathing, roof insulation, ice dam membrane.
 - 2) Roofing panels, including mounting system and seaming.
 - 3) All fascia and soffit conditions.
 - 4) All flashing and counterflashing conditions, including:
 - a) Eave, rake, hip and ridge conditions.
 - b) Roof/vertical wall intersections.
 - c) Roof penetrations.
 - d) All reglet conditions.
 - 5) All miscellaneous clips, angles, plates, brackets, closures and sealants.
 - 6) Gutter and downspouts.
 - 7) Snow retention system.
 - 3. Panels shall be same panels as specified or approved for Project.
 - a. Exact color is not necessary; however, Contractor is to label each exposed component to identify final installed color of component.
 - 4. Step construction to allow observation of all components.
 - 5. Construct additional mock-ups or rework existing mock-ups until acceptable to Engineer.
 - 6. Maintain mock-ups at project site until Engineer approves removal of mock-ups.
 - 7. Approved mock-ups to constitute minimum acceptable standard of quality for actual construction.

- D. Completed roof system to be inspected by roof manufacturer's authorized factory trained representative prior to issuance of roof warranty.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. Steep Slope: Having a pitch of 3:12 or greater.
- C. Low Slope: Having a pitch less than 3:12 but greater than 1/4:12.
- D. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

- A. Prefinished, field-insulated, structural standing seam metal roof system, including but not limited to:
 - 1. Ice dam membrane.
 - 2. Vapor retarder.
 - 3. Roof insulation.
 - 4. Structural standing seam metal roof panels.
 - a. Roof panel support and attachment system to be determined by standing seam roof manufacturer.
- B. All flashing and miscellaneous trim required for a complete water and airtight system, including but not limited to:
 - 1. Flashing.
 - 2. Counterflashing.
 - 3. Sealants.
- C. Standing seam fascia system.
- D. Snow retention system.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings:
 - a. Manufacturer prepared computer generated Drawings showing anchorage, flashing, jointing and all other accessories required and all special detailing required by the system.
 - 1) Minimum plan scale: 1 IN = 8 FT.
 - 2) Minimum detail scale: 1-1/2 IN = 1 FT.
 - b. Provide complete erection plan for each building structure with all details and sections referenced, all penetrations shown, expansion joints shown, detailed and referenced, and all special conditions identified, referenced and detailed.
 - c. Erection plan to identify limits of each different substrate material (decking).
 - d. Provide distinction between factory and field assembled work.
 - 3. Product technical data including:
 - a. Manufacturer data sheets on each component, including masonry reglets used in the roof system.
 - b. Acknowledgement that products submitted meet requirements of standards referenced.
 - 1) Certification by manufacturer that roofing assembly being supplied has been successfully tested under UL 580 procedures and has achieved a Class 90 rating.
 - 4. Test results:
 - a. UL 580, Class 90 test data.

- b. ASTM E1592 test results.
 - 1) Provide results of tests conducted in accordance with ASTM E1592 for panel size and gage and clip type and spacing similar to panels and clips being used.
 - c. ASTM E1646 and ASTM E1680 test results.
 - d. Concentrated load test data.
 - 1) Load test to be conducted on panel size, gage and with clip spacing as required.
 - 5. Qualifications:
 - a. Manufacturer: Provide structural engineer qualifications.
 - b. Contractor:
 - 1) Certification of approval or license to install product from manufacturer.
 - 2) Certification of experience.
 - 3) Listing of projects completed in the past two years with similar scope.
 - 4) Completed projects information to include, square footage of roofing installed, dollar value of roofing installed, manufacturer and type of roofing installed and contact name and telephone number of building Owner.
 - c. Installer: Provide qualifications of all personnel expected to be working on the Project.
 - 6. Roofing manufacturer's letter of approval for insulation proposed for use.
 - 7. Warranty: Sample language of manufacturer's warranty to be provided on this Project.
 - 8. Structural Engineer's sealed and signed calculations certifying that system structural components meet the requirements for lateral, upward and downward loads specified.
- B. Samples:
- 1. General: Tag, identify and provide statement regarding use for all fasteners, anchor clips, closures and sealants.
 - 2. Roof panel:
 - a. Two samples, full width, 24 IN long.
 - b. Provide color selected or specified when possible.
 - 3. Fasteners.
 - 4. Anchor clips.
 - 5. Closures, (both metal and non-metallic).
 - 6. Factory and field applied sealants.
 - 7. Color samples:
 - a. For initial preliminary color selection, provide manufacturer's color chart showing all colors available.
 - b. For final color selection, provide two 2 IN x 3 IN colored metal samples, for each color selected during the initial color selection.
- C. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23
 - b. for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
- 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Final warranty.

1.6 WARRANTY

- A. Provide 10-year complete system warranty, including material for air and weather tightness of entire roof assembly signed by manufacturer.
 - 1. Warranty limits shall meet the minimum load capacity requirements of ASTM E1592.
- B. Provide manufacturer's 20-year warranty on panel finish against fading, chipping, cracking and peeling of the panel exterior finish and/or erosion of substrate metal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Metal roofing and standing seam fascia products specified are manufactured by Centria.
- B. Manufacturers listed and other manufacturers not listed, but capable of meeting this Specification Section, are expected to provide a system with similar profile, standing seam height, spacing, construction and factory applied finish.
- C. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Metal roofing and standing seam fascia:
 - a. CENTRIA by NCI Building Systems.
 - b. Merchant & Evans, Inc. - ZIP-RIB.
 - c. IMETCO.
 - d. Other manufacturers capable of providing structural standing seam system and profiles similar to that specified will be considered (or equal).
 - 2. Vapor retarder:
 - a. Griffolyn by Reef Industries, Inc.
 - b. Or equal.
 - 3. Ice dam membrane.
 - a. GAF.
 - b. Carlisle Coatings & Waterproofing.
 - c. Owens Corning.
 - d. Or equal.
 - 4. Insulation:
 - a. Any manufacturer meeting these specifications and approved by metal roofing manufacturer.
 - 5. PVDF resin:
 - a. PPG IdeaScapes - DURANAR.
 - b. Valspar - Fluropon.
 - c. Arkema - Kynar 500.
 - d. Solvay - Hylar 5000.
 - e. Solvay - Hylar 5000.
 - 6. Snow retention system:
 - a. S-5! Attachment Solutions by Metal Roof Innovations, Ltd.
 - 7. Soffit panels: Provided by metal roofing panel manufacturer.

2.2 MATERIALS

- A. Roof and Fascia Panels:
 - 1. General:
 - a. Galvalume steel, ASTM A792/A792M, Class SS, Grade 50B.
 - 1) Painted surfaces: AZ50.
 - 2) Unpainted surfaces: AZ55.
- B. Insulation:
 - 1. Rigid polyisocyanurate.
 - a. Approved by roofing manufacturer.
- C. Perimeter Trim, Panel Closures, Flashing and Counterflashing: Material and factory applied finish to match roof panels.
- D. Fasteners: 300 series stainless steel, ASTM F593.
- E. Intermediate Support System:
 - 1. Galvanized steel: ASTM A653/A653M, Class SS, Grade 50, G90.
- F. Sealant: Manufacturer's standard non-curing butyl.

- G. Ice dam membrane.
 - 1. Self-adhesive, polymer modified bituminous sheet.
 - 2. Thickness: Minimum 40 MIL.
 - 3. Manufactured to meet ASTM D1970/D1970M.
 - 4. Non-slip surface.
 - 5. Acceptable to roofing manufacturer.

2.3 ACCESSORIES

- A. Vapor Retarder:
 - 1. ASTM E1745, Class A rated.
 - 2. Water vapor permeance: ASTM E96/E96M, 0.03 maximum.
 - 3. Tensile strength: ASTM D882, 275 FT-LB.
 - 4. Puncture strength: ASTM D4833/D4833M, 72 FT-LB.
 - 5. Griffolyn Type 105.
 - 6. Vapor retarder tape: As recommended by vapor retarder manufacturer.
- B. Roof Insulation:
 - 1. Rigid polyisocyanurate foam board.
 - a. ASTM C1289, Class I, Type II.
 - b. Compressive strength: 20 PSI minimum.
 - c. Density: 2 PCF minimum.
 - d. Thermal resistance (R-Value): 7.2/IN.
 - e. Water vapor transmission: ASTM E96/E96M, less than 1.0 perms.
 - f. Water absorption: ASTM C209, less than 1.0 PCT.
 - g. Thickness noted on Drawings.
 - h. Acceptable to roof manufacturer.
- C. Roof Penetration Flashing:
 - 1. Round penetrations:
 - a. Premolded EPDM boot with metal collar.
 - b. Buildex "DEK-TITE."
- D. Flashing Curb:
 - 1. Provided by metal roofing manufacturer.
 - 2. One-piece completely seal welded prefabricated roof curb, including vertical flashing, and counter flashing, cricket on high side of penetration and flat pan fabricated to replace standing seam metal roof panel.
 - 3. Size as required for penetration.
 - 4. Bottom sloped to match roof.
 - a. Level on top.
 - 5. Minimum 16 GA galvanized steel.
 - a. Finish to match roof panel.
- E. Foam and metal closures, sealant, gaskets, fasteners, washers, clips, angles, and all miscellaneous trims shall be provided by roofing manufacturer, fabricated for the specific condition as required.
- F. Soffit Panels:
 - 1. Minimum 0.032 IN aluminum, ASTM B209.
 - 2. Factory applied finish to match roof panels.
 - 3. AAMA 2605.
 - 4. Profile: Flat interlocking sheet with reinforcing ribs as required to prevent warping and oil canning.
 - 5. Panel joints shall match standing seam spacing of roof panels when possible.
 - 6. Provide soffit vent panels where indicated on Drawings.
 - a. If not indicated, provide vent panels at maximum 4 FT OC with minimum of three vent panels per side of building.

- b. Vent panels shall be compatible with and supported by soffit panel systems.
- c. Vent panels shall have minimum 10 PCT free area and shall have the maximum amount of panel face perforations allowed structurally.
 - 1) Perforations to be in the form of holes, minimum 3/32 IN and maximum 1/8 IN DIA, equally spaced on staggered centers from row to row.
- d. Vent panels shall be same size and profile as solid panels.
 - 1) Factory applied finish to match solid panels.
- 7. Hat shaped steel channel sub-framing:
 - a. 1IN deep x 20 GA steel.
 - b. Galvanized, ASTM A653/A653M, G90.
- G. Snow Retention System:
 - 1. Mechanical non-penetrating system for sloped metal roof systems to prevent ice and snow from sliding off roof.
 - a. Provide splice fittings for a continuous installation.
 - 2. Snow retention system shall consist of aluminum extrusion secured to the standing seam with non-penetrating stainless steel set screws having rounded points.
 - 3. Aluminum:
 - a. Finish: Manufacturer's standard finish.
 - b. Extrusion to have receptacle in face to provide for insertion of prefinished sheet metal strip to match roofing color.
 - 4. Snow/Ice clips:
 - a. Aluminum or stainless steel.
 - b. Provide with rubber foot on end that sits on the metal roof pan.
 - 5. Metal Roof Innovations, Ltd. S-5! "ColorGard" system.

2.4 FABRICATION

- A. General:
 - 1. Fabricate with square, true corners, mitered and welded.
 - 2. Fabricate trim, flashings and closure pieces to match panel profile and finish.
 - 3. Hem all edges.
 - 4. Fabricate panels in full length with no end laps.
- B. Standing Seam Metal Roof Panels:
 - 1. Profile: Centria "SRS" System, or equal.
 - 2. Height of standing seam: 2 IN.
 - 3. Gage: Minimum 24.
 - 4. Width:
 - a. 16 IN.
 - b. Longitudinal stiffening elements to minimize oil canning.
 - 5. System shall be designed as a true structural standing seam shape.
 - 6. Finish:
 - a. PVDF based with minimum 70 PCT resin.
 - b. Three-coat system having minimum 0.8 MIL epoxy primer coat on both sides of panel with a 0.8 MIL PVDF resin color coat and a 0.8 MIL PVDF resin clear top coat on the exterior side of the panel.
 - c. Meet or exceed requirements of AAMA 621.
 - d. Smooth finish.
 - e. Color:
 - 1) To be selected from manufacturers full range of primary and secondary colors.
 - a) Does not include exotic, metallic flake or iridescent colors.
 - 7. Concealed fasteners:
 - a. Provide concealed fasteners in all locations.
 - b. If exposed fasteners are required by the roof panel manufacturer, because of location, constructability issues or other critical design requirement, finish of fastener shall match roof panel finish.

- 1) Exposed fasteners are to be approved by Engineer.
 - c. The use of deflection limiter devices is not allowed.
- C. Intermediate Support System:
- 1. Roof panel anchor clips:
 - a. Manufacturer's standard one-piece clip suitable for condition.
 - 1) Two-piece clips are acceptable if required by roofing manufacturer.
 - b. Minimum 16 GA steel.
 - 1) Galvanized, ASTM A653/A653M, G90.
 - 2. Roof panel manufacturer shall be responsible for designing and providing all necessary intermediate "Z" or "hat-shaped" or other miscellaneous support members as required to transfer roof panel loads into building roof framing members.
 - a. Design in accordance with Building Code and loads shown on the Drawings.
 - 3. Bearing plates:
 - a. Sized by roofing manufacturer for roof loading indicated.
 - b. Minimum 16 GA steel.
 - 1) Galvanized, ASTM A653/A653M, G90.

2.5 SOURCE QUALITY CONTROL

- A. Roof assembly to be Class A roof covering assembly per UL 1256 or FM 4450.
- B. Structural Testing:
 - 1. The system shall be designed to safely resist the positive and negative loads per Building Code and as shown on Drawings.
 - 2. Structural-uniform uplift load capacity of the panel system shall be determined in accordance with ASTM E1592.
 - a. The factor of safety on the test results shall be 1.65 for the panel, batten or clip ultimate loads with no increase for wind.
 - b. The factor of safety for fasteners shall be 3.0 for one single fastener per clip, 2.25 for two fasteners per clip and 4.0 IN masonry.
 - c. Design uplift capacity for conditions of gage, span or loading other than those tested may be determined by interpolation of test results.
 - 1) Extrapolation of conditions outside the range of the tests is not acceptable.
 - d. Deflection shall be L/180 for positive loading.
- C. Water Penetration: No uncontrollable leakage at minimum 6.4 PSF when tested in accordance with ASTM E1646.
- D. Air Infiltration: Maximum 0.036 SCFM/SQFT when tested at 4.0 PSF differential pressure when tested in accordance with ASTM E1680.
- E. Fire Resistance/Wind Uplift Rating:
 - 1. UL 790, Class 1.
 - 2. UL 580, Class 90.
- F. The panels shall withstand a 250 LB concentrated load applied to a 4 SQIN area at the center of the panel at mid span between supports with no panel deformation, rib buckling, or panel sidelap separation which will adversely affect the weather tightness of the system.
- G. Support roofing panels on top of roof insulation using bearing plates attached to the structural frame or connect to manufacturer-provided intermediate support system.
 - 1. Bearing plate and standing seam roof panel anchor clip attachment is to be determined by the roofing manufacturer and shall take precedent over this Specification.
 - a. Provide attachment to roof structural frame or deck as required for loading criteria specified.
 - 2. Roof panel anchor clips shall be designed to allow thermal movement of the panels except where specific fixed points are indicated.

- a. Roof panel manufacturer shall be responsible for determining fixed point locations unless otherwise indicated.
 3. Wood blocking shown at roof edge is strictly for attachment of miscellaneous flashings and shall not be used for any structural value.
 4. Maximum spacing of roof clips shall be determined by manufacturer.
- H. Roof panel manufacturer shall be responsible for designing and installing all necessary expansion joints in the roof system.
1. Where roof expansion joints occur, provide corresponding expansion joints in fascia, soffit and gutters.

2.6 MAINTENANCE MATERIALS

- A. Provide Owner with 4 OZ of touch-up paint to match each different color used in the system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Install products in accordance with manufacturer's instructions, SMACNA (where referenced) and details shown on Drawings for a complete weathertight installation without waves, warps buckles or distortions.
 - a. Provide all closures, trim, angles, plates, sealant, gaskets, fasteners, washers, etc., as necessary.
 2. Attachments shall allow for thermal expansion and contraction.
 3. Seal all joints as required for watertight installation.
 4. Touch-up paint all damaged surfaces.
- B. Vapor Retarder:
1. Install on winter warm side of roof assembly in accordance with manufacturer's recommendations.
 2. Lap joints minimum: 4 IN.
 3. Seal to perimeter, tape all joints and repair all tears.
- C. Roof Insulation:
1. Install in accordance with manufacturer's recommendations.
 2. If multiple layers are provided to achieve total thickness as shown on Drawings, stagger joints minimum 12 IN in each direction.
- D. Ice Dam Membrane:
1. Install per manufacturer's recommendations in areas indicated on Drawings.
 2. Provide ice dam membrane from eave line to a point that is a minimum of 36 IN horizontally inside the interior face of the exterior wall.
 3. Provide at all ridges, hip ridges and hip valley lines extending minimum 36 IN up the slope at valleys and down the roof slope each side of the ridge line.
- E. Standing Seam Roofing Panels:
1. Install in one continuous length from ridge to eave.
 2. Hand crimp battens at each clip.
 3. Seam panels and battens together with portable electric seaming machine supplied by the manufacturer.
- F. Snow Retention System:
1. Install starting 2 FT from the eave edge of the roof.
 2. Install system in continuous lengths using manufacturer provided splice fittings.
 3. Mount to metal roofing utilizing clamps fastened to standing seam with non-penetrating bullet-nosed set-screws.

- a. Fasteners shall be compatible with roof panel system and shall not void any roof warranties.
 - b. Fasteners shall not damage panel finish.
 4. Install metal color strip in face of extrusion.
 - a. Color strip to match color of standing seam roofing.
 5. Provide snow/ice clips in each standing seam panel laterally across the roof or as recommended by manufacturer.
 - a. Provide single clip for seam spacing of less than 16 IN and two clips for seam spacing 16 IN and greater.
- G. Gutters:
1. Install gutters using gutter straps in accordance with SMACNA Table 1-8 and Figure 1-12 and per roofing manufacturer's recommendations.
 - a. Provide gutter brackets or hangers at 24 IN OC maximum.
 - b. Provide expansion joints in gutters per SMACNA and at expansion joint locations shown on Drawings.
 - c. Install gutters to provide positive drainage to downspout locations.
 - d. Seal all joints in gutters to provide completely water tight system.
- H. Downspouts:
1. Install downspouts in locations shown on the Drawings.
 2. Provide downspout hanger straps per SMACNA Figure 1-35 as appropriate for downspout style.
 3. Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
 4. Seal all joints in downspout for a complete watertight system.
 - a. Angle bottom of downspout out away from building.
 5. Fasten hanger straps to building wall with stainless steel screws and anchor sleeves appropriate for wall construction.
 - a. Provide minimum of two fasteners per strap.
 6. Maximum spacing of hanger straps shall be 10 FT with minimum of two hanger straps per vertical piece of downspout.
 7. Spacing and location of hanger straps shall be consistent from downspout to downspout.

END OF SECTION

SECTION 07 62 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Architectural flashing and sheet metal work.
 - 2. Factory formed coping system(s).
 - 3. Prefinished through-wall overflow scuppers.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 04 05 23 - Masonry Accessories.
 - 2. Section 07 54 25 - Fully Adhered TPO Roofing.
 - 3. Section 07 61 13 - Metal Roofing.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 2. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
 - a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
 - 3. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - c. B32, Standard Specification for Solder Metal.
 - d. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. FM Global (FM).
 - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Architectural Sheet Metal Manual.
- B. Qualifications:
 - 1. Sheet metal fabricator shall have minimum 10 years experience in fabrication of sheet metal items similar to items specified.
 - 2. Sheet metal installer shall have minimum five years experience installing sheet metal items specified.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.

- b. Manufacturer's installation instructions.
 - 2. Fabrication and/or layout drawings.
 - a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
 - 1) Minimum plan scale: 1/8 inches = 1 foot.
 - 2) Minimum detail scale: 1-1/2 inches = 1 foot.
 - 3. Fabricator qualifications.
 - 4. Installer qualifications.
- B. Samples:
 - 1. Finish and color samples for each product specified for Engineer preliminary color selection.
 - 2. For final color selection, provide two, 2 inches x 3 inches colored metal samples for each color selected during the preliminary color selection.
- C. Informational Submittals:
 - 1. Warranty: Manufacturer's sample warranty language.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Pre-finished sheet metal:
 - a. Carlisle SynTec Systems.
 - b. Holcim Elevate.
 - c. Petersen Aluminum Corporation.
 - 2. Factory-formed coping system.
 - a. Hickman Edge Systems.
 - b. Metal Era.
 - 3. Butyl sealant:
 - a. Pecora Corporation.
 - b. Sika.
 - c. Tremco Commercial Sealants & Waterproofing.

2.2 MATERIALS

- A. Sheet Metal:
 - 1. Aluminum: ASTM B209.
 - 2. Galvanized Steel: ASTM A653/A653M.
 - 3. Stainless Steel: ASTM A666.
 - a. Type 304.
- B. Fasteners: Non-ferrous compatible with sheet metal.
- C. Sealants:
 - 1. Non-curing Butyl Sealant:
 - a. Pecora "BA-98".
 - b. Sika "SikaLastomer 511".
 - c. Tremco "TremPro JS-773".
 - 2. Building sealants:
 - a. See Specification Section 07 92 00.
- D. Fasteners: Non-ferrous compatible with sheet metal.
- E. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel.
- F. Solder: ASTM B32.

G. Dissimilar Metal Protection: Comply with Specification Section 09 96 00.

H. Reglets: See Specification Section 04 05 23.

2.3 MANUFACTURED ITEMS

A. Factory Formed Coping System:

1. Formed coping piece which locks to anchor plate fastened to top of wall.
2. ANSI/SPRI ES-1 tested.
3. FM approved.
4. Coping cover:
 - a. Aluminum.
 - 1) Thickness: 0.050 inches.
5. Anchor plate: Galvanized steel, minimum 20 GA.
6. Splice plates: Aluminum, minimum 0.032 inches.
 - a. Continuous, minimum 6 inches long.
 - b. Front and back legs with extruded butyl seal.
 - c. Finish: Match coping.
7. Factory fabricated accessories, including but not limited to:
 - a. Corners, end caps, end terminations.
 - b. All accessories to be factory mitered and welded.
8. Profile:
 - a. Metal-Era "Perma-Tite Tapered."
 - b. Front leg: 6 inches.
 - c. Back leg: 5 inches.

B. Finish:

1. PVDF coating with minimum 70% resin content.
 - a. Meet requirements of AAMA 2605.
 - 1) Color: Matching EIFS. See Section 07 24 13 - Polymer-Based Exterior Insulation and Finish System.

2.4 FABRICATED ITEMS

A. General:

1. Shop fabricate items to maximum extent possible.
 - a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
 - 1) Shop fabricate and weld or solder all corners.
2. Pre-finished aluminum:
 - a. Thickness: Minimum 0.050 inches.
 - b. Texture: Smooth.
 - c. Coated on exposed face with PVDF coating having a minimum 70% resin content and a minimum 1.0 mil dry film thickness.
 - 1) Meet requirements of AAMA 2605.
 - 2) Color: Match coping.

B. Overflow Scuppers:

1. Matching existing through-wall scupper design.
 - a. Size and location(s) as shown on Drawings.

C. Scupper and Conductor Head:

1. Roofing manufacturer's recommended through-wall scupper design.
 - a. Size and location(s) as shown on Drawings.
2. Conductor head profile per SMACNA Figure 1-25F.
 - a. Provide 1 inch x 4 inches overflow opening with drip edge on front face of conductor.
3. 4 inches long outlet tube.
 - a. Size and shape to match downspout.
4. Debris screen:
 - a. Installed in top of conductor head.

- b. 1/4 x 1/4 inches aluminum mesh screen.
 - c. Screen shall be removable without damage to screen or conductor head.
- D. Retainer Clips and Continuous Cleats:
- 1. 0.050 inches stainless steel.
 - 2. Fabricated in longest practical lengths.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide items to be built into other construction to Contractor in time to allow their installation.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings.
- B. Weld aluminum to achieve weathertight joints and required details.
- 1. Do not weld slip joints.
 - 2. Touch-up damaged prefinished items.
- C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
- 1. Surface applied terminations will be allowed only where specifically detailed or otherwise approved in writing by the Engineer.
 - 2. Provide counterflashing at all reglets.
 - 3. Seal reglets and counterflashings in accordance with Specification Section 07 92 00.
- D. Fasten materials at intervals recommended by SMACNA.
- E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
- 1. Maximum spacing: 10 feet on-center.
 - 2. Provide slip joint 24 inches from corners.
 - 3. Provide slip joint at each vertical expansion joint location in wall.
 - a. Provide break in continuous cleat at each vertical expansion joint.
 - b. The above expansion joints do not include brick veneer expansion joints.
- F. Seal slip joints with two beads of non-curing butyl sealant on each side of slip joint overlap.
- G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures.
- H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete.
- I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.
- 1. Provide all components necessary to create weather-tight junctures between roofing and sheet metal work.
- J. Installation of Scupper and Conductor Head:
- 1. Flash the opening in the parapet wall and install the scupper and conductor head as indicated in SMACNA Figure 1-27A.
 - 2. Seal all joints to provide complete weathertight installation.
 - 3. Flash roofing material onto scupper per roofing manufacturer's recommendations.

END OF SECTION

SECTION 07 84 00 FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Firestopping of joints, through-wall penetrations, and membrane penetrations of fire-resistance rated construction.
 - 2. Selection of firestopping assemblies.
 - 3. Engineering Judgments.
 - 4. Special Inspections.
- B. Related Specification Sections include but are not necessarily limited to:

1.2 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. E814, Standard Method of Fire Tests of Through Penetration Fire Stops.
 - b. E1399, Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
 - c. E1966, Standard Test Method for Fire Resistive Joint Systems.
 - 2. International Firestop Council (IFC).
 - a. Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs), referred to herein as IFC Recommended Guidelines.
 - 3. National Fire Protection Association (NFPA).
 - a. 820, Fire Protection in Wastewater Treatment and Collection Facilities.
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 263, Fire Tests of Building Construction and Materials.
 - b. 1479, Fire Tests of Through Penetration Fire Stops.
 - c. 2079, Standard for Tests for Fire Resistance of Building Joint Systems.
- B. Qualifications:
 - 1. Firestop system installations must meet the requirements of ASTM E814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of the construction being penetrated.
 - 2. Proposed firestop systems shall conform to applicable governing codes having local jurisdiction.
 - 3. For those fire stop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents shall follow the requirements set forth by the International Firestop Council.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data, including:
 - a. Manufacturer's listed design number.
 - b. Manufacturer's installation instructions.

- c. Manufacturer's specification and technical data for each material including the composition and limitations.
 - d. Data sheet for all products and accessories used.
 - e. Detailed drawings of special conditions:
 - 1) Provide UL listing for each type of firestopping assembly to be used.
 - 2) When UL listing is not available, provide a written Engineering Judgment in accordance with IFC Recommended Guidelines.
 - a) Engineering Judgments shall be sealed by a Fire Protection Engineer licensed in the state of Idaho.
- B. Information Submittals:
- 1. Provide documents to the Owner of all listed systems installed and all engineering judgments.
 - 2. Provide documentation of Special Inspection of Firestopping.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled original, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with the manufacturer's requirements, including temperature.
- D. Do not use damaged or expired materials.

1.6 PROJECT CONDITIONS

- A. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- B. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- C. Do not proceed with the installation of firestop materials when the ambient temperature is outside the manufacturer's recommended limitations for installation and curing times as printed on the product label and product data sheet.
- D. During installation provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.
- E. Perimeter of, and all penetrations through, walls separating unclassified rooms and rooms classified per NFPA 820, shall be gas-tight to meet the definition of "Physically Separated".
 - 1. The entire building is unclassified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Safing insulation:
 - a. Johns Manville.
 - b. Owens-Corning.
 - c. Fibrex.
 - d. Roxul.
 - 2. Expanding silicone elastomer:
 - a. Any manufacturer UL listed for system used.
 - 3. Firestop sealant:

- a. Dow Corning.
- b. 3M Company.
- c. Specified Technologies Inc.
- d. Hilti.
- 4. Moldable putty:
 - a. 3M Company.
 - b. Specified Technologies Inc.
 - c. Hilti.
 - d. Rector Seal.
- 5. Fire barrier pillows:
 - a. 3M Company.
 - b. Specified Technologies Inc.
 - c. Hilti.
- 6. Collars:
 - a. 3 M Company.
 - b. Specified technologies Inc.
 - c. Hilti.
- 7. Expanding Foams:
 - a. 3 M Company.
 - b. Hilti.

2.2 MATERIALS

- A. General:
 - 1. Use only materials that have been tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate item.
 - a. Openings and Penetrations: UL 1479 or ASTM E814.
 - b. Building Joint Systems: ASTM E1966 and ASTM E1399, or UL 2079.
 - c. Perimeter Fire Barrier Systems: ASTM E2307.
- B. Safing Insulation:
 - 1. ANSI/UL 263.
 - 2. UL listed, product category BZJZ, Batts and Blankets.
- C. Expanding Silicone Elastomer: UL listed.
 - 1. Fill, Void or Cavity Materials: Product category XHHW.
 - 2. Through Penetration Firestop Systems: Product category XHEZ.
- D. Firestop Sealant: UL listed installed as required by the listed design.
- E. Moldable Putty: UL listed, product category QCSN or CLIV, Wall Opening Protective Materials.
- F. Firestop collars: UL Listed.
- G. Fire Barrier Pillows:
 - 1. UL listed.
 - 2. Removable and reusable.
 - 3. Pillows have self-locking feature.
- H. Backer rod and/or compressible filler: UL listed, product category XHHW, Fill, Void or Cavity Materials.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:

1. Selection and installation of firestopping assemblies is entirely the responsibility of the Contractor.
 2. All firestopping shall be provided in accordance with the building code and UL listing requirements as necessary to provide the required fire-resistance rating.
 3. When UL listing is not available, install in accordance with approved written Engineering Judgment.
 4. All firestopping products shall be installed in accordance with the manufacturer's instructions.
 5. Where firestopping will be exposed to view, provide colors matching adjacent construction or, if approved by manufacturer, and after inspection and approval by AHJ, paint to match.
 6. Where firestopping is not exposed to view, provide manufacturer's standard color.
- B. Openings and Penetrations:
1. Provide firestopping assembly for all openings, through-penetrations, and membrane penetrations in fire-rated construction.
 - a. Provide Flame (F), Thermal (T), Smoke (L), and Water (W) rated assemblies as necessary to meet building code requirements.
- C. Building Joint Systems:
1. Provide firestopping assembly for all joint assemblies in or between fire-resistance-rated walls, floors or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
- D. Refer to Specification Section 01 73 20 for openings and penetrations requiring fire stopping.

3.2 IDENTIFICATION

- A. Prior to acceptance by the Owner, provide written statement that all fire-rated penetrations have been sealed using products specified in accordance with UL requirements for required rating.
- B. Provide documents to the Owner of all listed systems installed and all engineering judgments.

3.3 FIELD QUALITY CONTROL

- A. Provide Special Inspection of all firestopping in accordance with IBC Chapter 17 and Specification Section 01 45 33.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sealing all joints which will permit penetration of dust, air or moisture.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 07 84 00 - Firestopping.
 - 2. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 302.1R, Guide for Concrete Floor and Slab Construction.
 - 2. ASTM International (ASTM):
 - a. C834, Standard Specification for Latex Sealants.
 - b. C920, Standard Specification for Elastomeric Joint Sealants.
 - c. C1521, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 - 3. National Fire Protection Association (NFPA).
 - a. 820, Fire Protection in Wastewater Treatment and Collection Facilities.
 - 4. NSF International (NSF):
 - a. 61, Drinking Water System Components -- Health Effects.
 - 5. Underwriters Laboratories, Inc. (UL).
- B. Qualifications: Sealant applicator shall have minimum five years experience using products specified on projects with similar scope.
- C. Mock-Ups:
 - 1. Before sealant work is started, a mock-up of each type of joint shall be sealed where directed by the Engineer.
 - a. The approved mock-ups shall show the workmanship, bond, and color of sealant materials as specified or selected for the work and shall be the minimum standard of quality on the entire project.
 - b. Each sample shall cure for a minimum of seven days at which time the sealant manufacturer's authorized factory representative shall perform adhesion tests on each sample joint.
 - 1) Perform adhesion tests per ASTM C1521.
 - 2) If mock-up is not acceptable or if adhesion test fails, provide additional mock-up and adhesion testing as required until acceptable to Engineer.

1.3 DEFINITIONS

- A. Defect(ive): Failure of watertightness or airtightness.
 - B. Finish sealant: Sealant material per this specification applied over face of compressible sealant or expanding foam sealant specified, to provide a finished, colored sealant joint.
 - C. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- "Interior wet areas": Toilets, showers, laboratories, truck wash bay, wet wells, and similar areas.

D. "Seal," "sealing" and "sealant": Joint sealant work.

1.4 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond breaker.
2. Certification from sealant manufacturer stating product being used is recommended for and is best suited for joint in which it is being applied.
3. Certification of applicator qualification.

B. Test Results:

1. Provide adhesion test results for each sealant sample including adhesion results compared to adhesion requirements.
2. Manufacturer's authorized factory representative recommended remedial measures for all failing tests.

C. Samples:

1. Cured sample of each color for Engineer's color selection.
2. Color chart not acceptable.

D. Informational Submittals:

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall indicate contents and expiration date on material.

1.6 PROJECT CONDITIONS

- A. Schedule installation of sealant work after completion of penetrating item installation but prior to covering or concealing of openings.
- B. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- C. Do not proceed with the installation of sealant materials when the ambient temperature is outside the manufacturer's recommended limitations for installation and curing times as printed on the product label and product data sheet.
- D. During installation provide masking and drop cloths to prevent sealant materials from contaminating any adjacent surfaces.
- E. Perimeter of, and all penetrations through, walls separating unclassified rooms and rooms classified per NFPA 820, shall be gas-tight to meet the definition of "Physically Separated".
 1. The entire building is unclassified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Acoustical sealant:
 - a. Pecora Corporation.
 - b. Master Builders Solutions.
 - c. Tremco Commercial Sealants & Waterproofing.
 2. Compressible sealant:

- a. Schul International Company, LLC.
- b. Emseal by Sika.
- c. Norton.
- d. Sandell Moisture Protection Systems.
3. Expanding foam sealant:
 - a. M-D Building Products, Inc.
 - b. DAP Products, Inc.
 - c. FAI International, Inc.
 - d. Power Fasteners.
4. Polyether sealants:
 - a. Master Builders Solutions.
 - b. Chem Link.
 - c. Tremco Commercial Sealants & Waterproofing.
5. Polysulfide rubber sealant:
 - a. Pecora Corporation.
 - b. Master Builders Solutions.
 - c. PolySpec by ITW Polymers Sealants.
6. Polyurea joint filler:
 - a. Dayton Superior Corporation.
 - b. Euclid Chemical Company.
 - c. L&M by LATICRETE International, Inc.
 - d. Master Builders Solutions.
7. Polyurethane sealants:
 - a. Pecora Corporation.
 - b. Sika.
 - c. Master Builders Solutions.
 - d. Tremco Commercial Sealants & Waterproofing.
8. Silicone sealants:
 - a. Chem Link.
 - b. GE Silicones.
 - c. Dow.
 - d. Tremco Commercial Sealants & Waterproofing.
9. Backer rod, compressible filler, primer, joint cleaners, bond breaker:
 - a. As recommended by sealant manufacturer.

2.2 MATERIALS

- A. Sealants - General:
 1. Provide colors matching materials being sealed.
 2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
 3. Nonsagging sealant for vertical and overhead horizontal joints.
 4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
 5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
 6. Sealant backer rod and/or compressible filler:
 - a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
 - 1) Control joint depth.
 - 2) Break bond of sealant at bottom of joint.
 - 3) Provide proper shape of sealant bead.
 - 4) Serve as expansion joint filler.
- B. Acoustical sealant:
 1. One component siliconized acrylic latex.
 2. Nonstaining, nonbleeding.
 3. Compatible with paints specified for adjoining materials.

- a. See Specification Section 09 96 00.
- 4. Meet ASTM C834.
 - a. Pecora - AC20+.
 - b. Tremco - Tremflex 834.
- C. Compressible Sealant:
 - 1. For joints exposed to wastewater fumes or vapor:
 - a. Closed cell ethylene vinyl acetate (EVA) foam with epoxy adhesive.
 - b. Schul "HydroStop".
 - 2. For all other applications: Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant.
 - a. Schul "Sealtite B".
 - 3. Adhesive: As recommended by sealant manufacturer.
- D. Expanding Foam Sealant:
 - 1. One or two component moisture cured expanding urethane.
 - 2. Shall not contain formaldehyde.
 - 3. Density: Minimum 1.5 pcf.
 - 4. Closed cell content: Minimum 70%.
 - 5. R-value: Minimum 5.0/IN.
 - 6. Flame spread: Less than 25.
 - 7. Smoke developed: Less than 25.
- E. Polyether Sealant:
 - 1. Silyl-terminated polyether polymer.
 - 2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
 - a. Master Builders Solutions MasterSeal 150.
 - b. Chem Link DuraLink.
 - c. Tremco Dymonic FC.
- F. Polysulfide Rubber Sealant:
 - 1. One or two component.
 - 2. Meet ASTM C920.
 - a. Pecora Synthacalk GC2+.
 - b. PolySpec THIOKOL 2235.
- G. Polyurea Joint Filler:
 - 1. Two component, semi-rigid material for filling formed or saw-cut control joints in interior concrete slabs.
 - a. Dayton Superior Corporation "Joint Fill, Joint Seal, Joint Saver II" as required for condition and recommended by manufacturer.
 - b. Euclid Chemical Company "EUCO QWIK" joint.
 - c. L&M "Joint Tite 750".
 - d. Master Builders Solutions MasterSeal "CR100" control joint filler.
 - 2. Comply with ACI 302.1R performance recommendations regarding control and construction joints.
 - 3. Color: Gray.
- H. Polyurethane Sealant:
 - 1. One or two components.
 - 2. Paintable.
 - 3. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
 - a. Pecora Dynatrol-IXL, Dynatrol II, Urexpan NR-200, NR-201.
 - b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2C NS/SL.
 - c. Master Builders Solutions MasterSeal NP-1, NP-II, SL-1 SL-2.
 - d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.

- I. Silicone Sealant:
 - 1. One component.
 - 2. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.
 - a. Chem Link DuraSil.
 - b. GE Silpruf, Silglaze II.
 - c. GE Sanitary 1700 sealant for sealing around plumbing fixtures.
 - d. Dow 786 for sealing around plumbing fixtures.
 - e. Dow 7565, 790, 791, 795.
 - f. Tremco Spectrem 1, Spectrem 3, Tremsil 600.
 - 3. Mildew resistant for sealing around plumbing fixtures.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system.
- B. Use only compatible materials.
- C. Where required by manufacturer, prime joint surfaces.
 - 1. Limit application to surfaces to receive sealant.
 - 2. Mask off adjacent surfaces.
- D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's recommendations.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and UL requirements.
- B. Clean all joints.
- C. Make all joints water and airtight.
- D. At changes in direction of joints, joint intersections and where sealant joints interface with other construction, install continuous sealant as necessary to ensure a weather-tight seal.
- E. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than one-half width of joint, but in no case less than 1/4 inches nor more than 1/2 inches unless recommended otherwise by the manufacturer.
- F. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to depth recommended by manufacturer:
 - 1. Take care to not puncture backer rod and compressible filler.
 - 2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.
- G. Apply bond breaker where required.
- H. Tool sealants using sufficient pressure to fill all voids.
- I. Upon completion, leave sealant with smooth, even, neat finish.
- J. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.
- K. Install compressible sealant to position at indicated depth.
 - 1. Size so that width of material is twice joint width.
 - 2. Take care to avoid contamination of sides of joint.
 - 3. Protect side walls of joint (to depth of finish sealant).
 - 4. Install with adhesive faces in contact with joint sides.
 - 5. Install finish sealant where indicated.

- L. Install expanding foam sealant to minimum 4 inches depth or thickness of wall being penetrated if less than 4 inches or as indicated on Drawings.
 - 1. Provide adequate backing material as necessary.
 - 2. Hold material back from exposed face of wall as necessary to allow for installation of backer rod and finish sealant.
 - a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish sealant.
 - 3. Trim off excess material flush with surface of the wall if not providing finished sealant.

3.3 SEALANT WORK

- A. General:
 - 1. Work includes but is not limited to: Sealing all joints which will permit penetration of dust, air, or moisture.
 - 2. Refer to SCHEDULE for materials to be used.
 - 3. See Specification Section 07 84 00 for firestopping.
- B. Concrete joints:
 - 1. Flooring joints.
 - 2. Isolation joints.
 - 3. Joints between paving or sidewalks and building.
 - 4. Construction, control and expansion joints.
 - 5. Joints between precast roof units and between precast roof units and walls.
 - 6. Joints between precast wall panels.
 - 7. Precast panel bearing joints:
 - a. At panels bearing at or above grade, seal both sides of panel base joint.
 - b. At panels bearing below grade:
 - 1) Seal exterior panel base joint prior to backfilling and/or placement of site paving.
 - 2) Provide compressible filler and sealant or backer rod and sealant as appropriate for interior slab condition.
- C. Masonry:
 - 1. Masonry control joints.
 - 2. Brick expansion joints.
 - 3. Cast stone coping and sill head joints.
 - 4. Glass masonry joints.
 - 5. Between masonry and other materials.
- D. Flashing, reglets and retainers.
- E. Wood siding and trim.
- F. Exterior Insulation and Finish System joints.
- G. Openings:
 - 1. Perimeters of door and window frames, louvers, grilles, etc.
 - 2. Door thresholds shall be set in a full bed of sealant.
 - 3. Glass and glazing: See specification Section 08 81 00.
- H. Interior finishes:
 - 1. Perimeter and penetrations of sound insulated walls.
 - 2. Expansion and control joints in tile work.
- I. Penetrations of walls, floors and decks.
- J. Other joints where sealant, expanding foam sealant or compressible sealant is indicated.

3.4 FIELD QUALITY CONTROL

- A. Adhesion Testing:
 - 1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:

- a. Water bearing structures: One test per every 1,000 linear foot of joint sealed.
- b. Exterior precast concrete wall panels: One test per every 2,000 linear foot of joint sealed.
- c. Chemical containment areas: One test per every 1,000 linear foot of joint sealed.
- d. Building expansion joints: One test per every 500 linear foot of joint sealed.
- e. All other type of joints except butt glazing joints: One test per every 3,000 linear foot of joint sealed.
- f. Manufacturer's authorized factory representative shall recommend, in writing, remedial measures for all failing tests.

3.5 SCHEDULE

- A. Furnish sealant as indicated for the following areas:
 - 1. Exterior areas:
 - a. Above grade: Polyether.
 - b. Below grade: Polyurethane.
 - 2. Interior areas:
 - a. Noncorrosive areas:
 - 1) Wet exposure: Polyether.
 - a) Toilet rooms, locker rooms, janitor closets or similar areas: Mildew resistant silicone.
 - 2) Dry exposure: Polyether, unless noted otherwise.
 - a) Sound insulated construction: Acoustical sealant.
 - b. Corrosive areas:
 - 1) Wet exposure: Polysulfide.
 - 2) Dry exposure: Polyurethane.
 - c. Sealant exposed to or having the potential of being exposed to concentrated chlorine gas or chlorine liquid: Polysulfide.
 - d. Casework, countertops and solid surface materials: Silicone.
 - 1) Sinks, fixtures or other areas subject to potential splash, spillage or condensation: Mildew Resistant Silicone.
 - 3. Immersion:
 - a. Prolonged contact with or immersion in:
 - 1) Potable water:
 - a) Polysulfide.
 - b) NSF 61 approved.
 - 2) Nonpotable water, wastewater or sewage: Polysulfide.
 - 4. Compressible sealant: Where indicated.
 - 5. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
 - a. Finish sealant:
 - 1) Exterior side:
 - a) Above grade: Polyether.
 - b) Below grade: Polyurethane.
 - 2) Interior side:
 - a) Noncorrosive area:
 - (1) Wet exposure: Polyether.
 - (2) Dry exposure: Polyether, unless noted otherwise.
 - b) Corrosive area:
 - (1) Wet exposure: Polysulfide.
 - (2) Dry exposure: Polyurethane.
 - 6. Interior concrete slab formed or saw-cut control joints: Polyurea joint filler.

END OF SECTION

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DIVISION 08

OPENINGS



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SECTION 08 16 13
FIBERGLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. FRP doors and frames.
 - 2. Steel door frames with high performance industrial coating finish.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 08 70 00 - Finish Hardware.
 - 2. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute/Steel Door Institute (ANSI/SDI):
 - a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
 - 2. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. A653/A653M, Standard Specification for Steel, Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - d. C1363, Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. National Fire Protection Association (NFPA):
 - a. 80, Standard for Fire Doors and Other Opening Protectives.
 - 4. Steel Door Institute (SDI):
 - a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
 - b. All applicable SDI publications.
 - 5. Steel Door Institute/American National Standards Institute (SDI/ANSI):
 - a. A250.10, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- B. Qualifications:
 - 1. Manufacturer shall have been producing products specified for minimum of 10 years.
 - 2. Installer shall have minimum of five years experience in the installation of fiberglass reinforced plastic doors and frames.
 - a. Experience shall include field repair of fiberglass and gel coating.
- C. Doors and frames shall be fabricated and prepared for hardware by single manufacturer except for fire rated frames.
- D. Door hardware and accessories are to be provided by others and installed in the field.
- E. All door hardware is to be provided per Specification Section 08 70 00.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 2. Schedule of doors and frames specific to this Specification Section, using same reference numbers as used on Drawings.
 3. Certification of manufacturer's qualifications.
 4. Certification of installer's experience.
 5. Certification that doors and frames have been protected against chemical exposures listed.
- B. Samples:
 1. Provide one, 6 x 6 inches sample of frame and one, 6 x 6 inches sample of standard door and sample of fire rated door specified.
 - a. Frame sample shall show corner construction.
 - b. Door sample shall show core specified and reinforcing construction.
- C. Contract Closeout Information:
 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
 1. Warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store doors and frames in a dry, weather protected area.
 1. Place units on wood skids providing a minimum 6 inches air space above the ground.
 2. Do not store units flat, set frames and doors on edge providing a minimum 1/2 inches air circulation space between each unit.
 3. Provide covering which will ensure air flow around each unit to prevent trapping moisture.
 4. If door wrapper becomes wet, remove immediately and provide dry protection equivalent to wrapper removed.
- B. Storage recommendations by unit manufacturer shall take precedence over the above requirements.

1.6 WARRANTY

- A. Warranty all FRP components to be free of defects in materials and workmanship for one year and from degradation or failure due to corrosion for minimum of five years from date of building acceptance.
 1. Warranty against door warpage of more than 1:100 when measured diagonally across the door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. FRP doors and frames:
 - a. Chem-Pruf.
 - b. CORRIM Company.
 - c. Special-Lite.
 - d. Universal Pultrusions.

2. Steel door frames:
 - a. Ceco Door by ASSA ABLOY.
 - b. Steelcraft by Allegion PLC.
 - c. Curries by ASSA ABLOY.
3. Only steel door frame manufacturers listed are approved for use.

2.2 MATERIALS

- A. Face Panel: Fiberglass reinforced plastic.
- B. Supports and Reinforcing: Non-swelling polymer or equivalent non-corrosive material.
- C. Inserts, Bolts and Fasteners: Stainless steel.
- D. Core:
 1. Non-fire rated:
 - a. Rigid, end grain balsa.
 - b. Thickness: Minimum 1-1/2 inches.
 - c. Density: 8.5 - 9.0 pcf.
 - d. Compressive strength: Minimum 1400 psi.
 2. Fire rated:
 - a. Mineral core.
 - b. Intumescent seals factory applied to perimeter of door.
 - c. Stiles and rails fabricated from pultruded fire retardant material.
 - d. Provide stainless steel channels on the meeting edges of pairs of doors having surface mounted vertical rod exit devices.
 - e. Rating as indicated on Drawings.
- E. Frames:
 1. Non-fire rated: Fiberglass reinforced plastic.
 2. Fire rated: Steel, ASTM A1008/A1008M.

2.3 ACCESSORIES

- A. Frame Anchors:
 1. Jamb anchors in masonry: 9 GA steel, masonry wire anchor, galvanized per ASTM A153/A153M, G60 coating.
 2. Floor anchors: 12 GA steel, galvanized per ASTM A153/A153M, G60 coating.
 3. Anchors in existing openings: Stainless steel machine screws and stainless steel expansion shield.

2.4 FABRICATION

- A. General:
 1. Fabricate rigid, neat in appearance and free from defects.
 2. Form to sizes and profiles indicated on Drawings.
 - a. Sizes indicated in DOOR SCHEDULE are nominal.
 - b. Refer to Architectural details for actual conditions affecting actual size of rough openings.
 3. Fit and assemble in shop wherever practical.
 4. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
 5. For door frames, all surfaces, both exposed and concealed, shall be gel coated to prevent acid attack of the glass reinforcing.
 6. Fabricate doors and frames to tolerance requirements of SDI 117.
 7. Fit doors to SDI and NFPA 80 clearances.
 8. Provide fire doors which are approved and labeled by UL.
- B. FRP Doors:
 1. General:
 - a. Construction:

- 1) 1-3/4 inches thick, minimum.
 - 2) Face sheets, 0.125 inches thick, minimum.
 - 3) Fabricate with flush top closure.
 - 4) Doors with a maximum size of 48 inches wide x 96 inches tall shall be fabricated in one piece.
 - 5) Doors taller than 96 inches shall be fabricated using panelized construction.
 - a) Panelized construction:
 - (1) Fabricate panels maximum 48 x 48 inches.
 - (2) All panels in any one door leaf shall be equally sized.
 - (3) All doors of the same size shall have the same number and size of panels.
 - (4) Connect panels together using 0.125 inches fiberglass or 14 GA Type 316 stainless steel "H" channels with maximum 3 inches face on each side and 1/4 inches stainless steel thru bolts at maximum 12 inches on-center spacing.
 - (5) Seal all panel connections for weather tight installation.
 - 6) Fill and dress all joints.
 - 7) Resin: Polyester or vinyl ester as required to meet chemical resistance requirements.
 - 8) Fiberglass content (by weight): Minimum 30%, maximum 40%.
 - 9) UV stabilized.
 - 10) Core:
 - a) End grain balsa for non-fire rated doors.
 - b) Mineral core for fire rated doors.
 - b. Finish:
 - 1) Minimum 15 mil gel coat thickness.
 - 2) Gel coat color:
 - a) Exterior doors: Selected by Engineer.
 2. Exterior:
 - a. SDI Grade III, Model 4, seamless with Balsa core.
 - 1) Face sheet 0.125 inches thickness.
 3. Fire rated:
 - a. SDI Grade II, Model 4, flush seamless.
 - b. Flame spread: 25 or less per ASTM E84.
 - c. UL fire labeled.
 - 1) Meet requirements of UL 10C.
 - d. Pairs UL fire labeled with astragal.
 - 1) Astragal: Steel.
 - a) Coat astragal with minimum 15 mil thick gel coat, color to match door.
 4. Interior (except fire rated):
 - a. SDI Grade II, Model 4, seamless with Balsa core.
- C. Frames:
1. General:
 - a. Frame size to be 2 inches x 5-3/4 inches with equal rabbets on each side.
 - b. One piece or if shipped knocked down, all joints shall be filled with fiberglass compound, ground and sanded smooth and finished with gel coat.
 - c. Minimum thickness: 0.1875 inches.
 - d. Resin: Polyester or Vinyl ester as required to meet chemical resistance requirements.
 - e. Fiberglass content (by weight): Minimum 30%, maximum 40%.
 - f. UV stabilized.
- D. Fire Rated Door Frames (Steel):
1. ASTM A1008/A1008M.
 2. UL labeled.
 3. Comply with requirements of UL 10B.
 4. 26 GA steel boxes welded to frame at back of all hardware cutouts.

5. 8 GA steel plate reinforcement welded to frame for hinge reinforcing.
 6. 12 GA steel plate reinforcement welded to frame for strikes, closers and surface-mounted hardware.
 7. Split type frames not acceptable.
 8. Conceal all fasteners.
 9. Continuously wire weld all joints and dress smooth.
 10. Knock down type frames are not acceptable.
 11. 16 GA steel galvanized per ASTM A653/A653M, G60.
 12. Prime painted in accordance with SDI/ANSI A250.10.
 13. Provide removable spreaders at bottom of frame.
 14. Factory coat all surfaces of frame with minimum 15 mil gel coating.
 15. Field-applied gel coating is not acceptable.
 16. See Specification Section 09 96 00 for finish coating of fire rated metal door frames.
- E. Factory prepare for finish hardware, in accordance with hardware schedule and templates provided by hardware supplier.
1. Locate hardware per ANSI/SDI A250.8.
 2. See Specification Section 08 70 00 for hardware.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install doors and frames, in accordance with SDI and manufacturer's instructions.
 1. Manufacturer's instructions take precedent over SDI.
- B. Place frames prior to construction of enclosing walls and ceilings.
- C. Plumb, align, and brace securely until permanently anchored.
- D. After completion of walls, remove temporary braces and spreaders.
- E. Install fire rated frames in accordance with NFPA 80 and manufacturer's instructions.
 1. Manufacturer's instructions take precedent over NFPA.
- F. Use plastic plugs to keep silencer holes clear during construction.
- G. Immediately after erection, repair damaged areas of gel coat and primer coat.
 1. Fill corner miter joints with fiberglass compound as recommended by frame manufacturer.
 - a. Filling miter joints with sealant is not acceptable.
 2. Sand filled area to match adjacent frame and coat with minimum 15 mil gel coating to match adjacent frame finish.
- H. On doors not requiring weatherstripping, sound seals or smoke seals, install three silencers on strike jamb of single door frame and two on head of double door frame.
 1. See Specification Section 08 70 00.
- I. Number and location of anchors shall be in accordance with frame manufacturer's recommendation with minimum of three anchors per jamb.
- J. Protect frames during construction.
- K. Cover all thru bolts and other stainless steel accessories with minimum 15 mil gel coating to match door frame.

3.2 FIELD QUALITY CONTROL

- A. Provide for services of manufacturer's authorized representative to be present during and observe the installation of the first three doors and frames.
 1. If project has less than three doors and frames, manufacturer's authorized representative shall be present for installation of all doors and frames.

2. Manufacturer's representative shall instruct installer on proper methods for installing doors and frames, repairing damaged gel coating, repairing scratches in finish and filling and finishing all joints.

END OF SECTION

SECTION 08 70 00
FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finish hardware.
 - 2. Inspection and testing of door operation.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 08 16 13 – Fiberglass Doors.
 - 4. Division 26 - Electrical

1.2 QUALITY ASSURANCE

- A. All door hardware shall be provided by a single hardware supplier.
 - 1. Hardware is to be provided under this Specification Section, unless noted otherwise, for doors specified in:
 - a. Specification Section 08 16 13.
- B. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 2. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
 - a. A156.1, Butts and Hinges.
 - b. A156.3, Exit Devices.
 - c. A156.4, Door Controls -Closers.
 - d. A156.6, Architectural Door Trim.
 - e. A156.8, Door Controls - Overhead Stops and Holders.
 - f. A156.13, Mortise Locks.
 - g. A156.16, Auxiliary Hardware.
 - h. A156.18, Materials and Finishes.
 - i. A156.21, Thresholds.
 - 3. American National Standards Institute/Steel Door Institute (ANSI/SDI).
 - a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
 - 4. Door and Hardware Institute (DHI).
 - 5. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
- C. Qualifications:
 - 1. Installation shall be inspected by a certified Architectural Hardware Consultant (AHC).

1.3 DEFINITIONS

- A. AHC: Architectural Hardware Consultant, certified by DHI.
- B. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

- C. All weather: Capable of operation from -50 to +120 DEGF.
- D. Active Leaf: Right-hand leaf when facing door from keyed side unless noted otherwise on Drawings.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Qualifications
 - a. AHC qualifications.
 - 3. Certification from AHC stating:
 - a. All door hardware has been reviewed by AHC and verified to be compatible with doors and frames.
 - 4. Certifications:
 - a. Certification from AHC stating all door hardware has been provided per approved Shop Drawings, has been installed in accordance with manufacturer's recommended installation instructions and all doors have been inspected and tested and found to be in proper working order.
 - 1) Door assemblies required to swing in the direction of egress have been inspected and tested in accordance with NFPA 101.

1.5 WARRANTY

- A. Provide all individual manufacturers' extended warranties as advertised.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Hinges:
 - a. Hager Companies.
 - b. McKinney Manufacturing Co.
 - c. Stanley by dormakaba Holding, Inc.
 - d. Or equal.
 - 2. Locksets and latchsets:
 - a. Best Access Solutions, Inc. by dormakaba Holding, Inc.
 - b. Corbin Russwin, Inc. by ASSA ABLOY.
 - c. Or equal.
 - 3. Exit devices:
 - a. Corbin Russwin, Inc. by ASSA ABLOY.
 - b. PRECISION by dormakaba Holding, Inc.
 - c. SARGENT Manufacturing Company by ASSA ABLOY.
 - d. Von Duprin by Allegion PLC.
 - e. Or equal.
 - 4. Closers:
 - a. Corbin Russwin, Inc. by ASSA ABLOY.
 - b. LCN by Allegion PLC.
 - c. Norton by ASSA ABLOY.
 - d. Or equal.
 - 5. Door stops and holders:
 - a. Trimco.
 - b. Rockwood by ASSA ABLOY.
 - c. IVES by Allegion PLC.
 - d. Or equal.

6. Overhead stops:
 - a. Glynn-Johnson by Allegion PLC.
 - b. Rockwood by ASSA ABLOY.
 - c. Trimco.
 - d. Rixson by ASSA ABLOY.
 - e. Or equal.
7. Weatherstripping and thresholds:
 - a. Pemko by ASSA ABLOY.
 - b. Reese Enterprises, Inc.
 - c. Zero International, Inc.
 - d. National Guard Products.
 - e. Or equal.
8. Door bolts, coordinators and strikes:
 - a. IVES by Allegion PLC.
 - b. Trimco.
 - c. Hager Companies.
 - d. Rockwood by ASSA ABLOY.
 - e. Or equal.
9. Other materials: As noted.

2.2 MATERIALS

- A. General: As indicated in the FABRICATION Article in PART 2 of this Specification Section.
- B. Fasteners: Stainless steel or aluminum.
- C. Closers:
 1. Standard closer:
 - a. Shell: Aluminum or cast iron.
 - b. Arms and piston: Forged steel.
- D. Kickplates:
 1. Stainless steel.
- E. Thresholds: Aluminum.
- F. Overhead Stops and Wall Stops: Stainless steel or aluminum.
- G. Keys: Brass or bronze.
- H. Weatherstripping and Smoke Seals: Polypropylene, neoprene, or EPDM.
- I. Pulls and Push Plates: Stainless steel.
- J. Silencers: Rubber.

2.3 COMPONENTS

- A. Hinges:
 1. Butt hinges:
 - a. ANSI/BHMA A156.1.
 - 1) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
 - b. Ball bearing.
 - c. Flat button tips.
 - d. Butt hinges:
 - 1) Hager BB1199.
 - 2) McKinney T4B3386.
 - 3) Or equal.
 - e. Hinge size:
 - 1) Doors up to and including 46 IN wide: 4.5 IN x 4.5 IN.
 - 2) Doors over 46 IN up to and including 60 IN wide: 5 IN high x 4.5 IN.

B. Mortise Locks and Latches:

1. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
 - a. Meet requirements of ADA.
2. Antifriction two-piece mechanical latchbolt with stainless steel anti-friction insert.
 - a. One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/ 16 IN thick with 1 IN throw.
 - b. 2-3/4 IN backset.
 - c. Cylinder: Brass, 6-pin, with interchangeable core.
 - d. ADA compliant thumb turn lever.
3. Locking, latching and retracting mechanism and lock case:
 - a. Steel, unless noted otherwise.
 - 1) Chrome or zinc dichromate plated.
4. Trim design: Corbin Russwin, Inc. "NSP", or equal.
 - a. Functions as indicated in following table in accordance with ANSI/BHMA A156.13.

MORTISE LOCK NUMBERS		
ANSI	FUNCTION	CORBIN RUSSWIN, INC.
F01	Passage	ML2010
F05	Classroom	ML2055
F07	Storeroom	ML2057
F13	Entrance or Office	ML2065
F19	Privacy	ML2030

C. Exit Devices:

1. ANSI/BHMA A156.3, Grade 1.
2. Type and function as indicated in the following table.

EXIT DEVICE NUMBERS		
TYPE	FUNCTION	VON DUPRIN
T1	Panic Exit Device	98 SERIES PUSH PAD
T2	Panic Exit Device (Active) with Flush Bolts (Inactive)	98 SERIES PUSH PAD

D. Door Closers:

1. ANSI/BHMA A156.4, Grade 1.
2. Size door closers to comply with ANSI recommendations for door size and location.
3. Fabricate all closers with integral back check.
4. Provide integral stop unless noted otherwise.
 - a. Do not provide integral stop at closers indicated to be installed on pull side of door.
 - b. Provide all weather fluid for all closers used in exterior doors and where otherwise indicated.
5. Full cover.
 - a. Manufacturer's standard plastic cover.
6. Arms, brackets, and plates: As required for complete installation.
7. Closers:
 - a. LCN 4040 Series or Norton 7500 Series or Corbin Russwin, Inc. DC6200 Series.
8. Provide manufacturer's standard 10-year warranty.

E. Overhead Door Holders/Stop:

1. ANSI/BHMA A156.8.

2. Provide 'hold-open' function on all stops unless noted otherwise.
 - a. Do not provide 'hold-open' function at fire rated doors.
 3. Surface mounted stops: Rockwood N14400 Series or Glynn Johnson 90 Series.
 4. Concealed stops: Rockwood N11000 Series or Glynn Johnson 100 Series.
- F. Kickplates:
1. ANSI/BHMA A156.6.
 2. 8 IN high x 2 IN less than door width.
 3. Beveled on all edges.
 1. Thickness:
 - a. Stainless steel: 0.050 IN.
- G. Thresholds:
1. ANSI/BHMA A156.21.
 2. One-piece unit.
 3. Height: 1/2 IN high maximum.
 4. Width: 4 IN
 5. Provide required bolt cutouts.
- H. Weatherstripping:
1. Weather seal at jambs and head:
 - a. Self-adhesive strip: Reese #797.
 - b. Color: Black.
 2. Sweep at bottom of doors:
 - a. Reese 701.
 - b. Color: Clear anodized.
 3. Weather seal astragal at meeting edges of pairs of doors:
 - a. Reese 92 each leaf.
 - b. Color: Clear anodized.

2.4 ACCESSORIES

- A. Silencers:
1. Hollow metal frames: Trimco 1229A or Rockwood 608.
 2. Self-adhesive silencers are not acceptable.
- B. Keying:
1. Establish keying with Owner.
 - a. Provide and set up complete visible card indexed system with key tags and control slips.
 - b. Tag and identify keys.
 - c. Provide two keys for each lock or cylinder.
 - d. Master key and key in groups as directed.
 - e. Provide construction master keys for all exterior doors.
- C. Strikes:
1. Curved lips.
 - a. Extended lips when required.
 2. Furnish strike boxes.
 3. Appropriate for function and hardware listed.

2.5 FABRICATION

- A. General:
1. Generally prepare for Phillips head machine screw installation.
 2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.
 3. Provide concealed fasteners unless thru bolted.
 4. Through bolt closers on all doors.

5. Furnish items of hardware for proper door swing.
 6. Furnish lock devices which allow door to be opened from inside room without a key or any special knowledge.
- B. Hardware:
1. Provide following ANSI/BHMA A156.18 finishes:
 - a. Locksets, latchsets and strikes: 630.
 - b. Door pulls, push bars, push plates: 630.
 - c. Kickplates:
 - 1) Stainless steel: 630.
 - d. Exit devices: 630 where available; 626 if 630 is not available.
 - 1) Provide 630 finish on trim.
 - e. Butt hinges: 630.
 - f. Door stops, dead locks, mortise bolts, and miscellaneous hardware: 630 where available, 626 if 630 not available.
 - g. Door overhead stops: 630.
 - h. Closers: 600 prime coat with 689 finish coat, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's installation instructions.
 1. Perform installation by or under the direct supervision of an AHC.
- B. Provide all hardware in accordance with Building Code.
- C. Fit hardware before final door finishing.
- D. Permanently install hardware after door finishing operations are complete.
- E. Locate hardware in accordance with ANSI/SDI A250.8.
- F. Butt Hinges:
 1. Provide non-removable pin (NRP) at:
 - a. Exterior doors.
 - b. Reverse handed doors equipped with locks.
 2. Quantities:
 - a. Door height 61 - 90 IN: Three.
 - b. Door height 91 - 114 IN: Four.
 - c. Door height 115 - 144 IN: Five.
 - d. Doors over 48 IN wide and over 96 IN high:
 - 1) Provide top butt hinge within 6 IN of the top of the door to top of hinge.
 - 2) Provide one additional butt hinge approximately 6 IN below the bottom of the top butt hinge.
 3. Provide power transfer as necessary where electrified lockset or exit device is specified or as otherwise indicated in Hardware Schedule.
- G. Closers:
 1. Mount closers on push side of doors unless noted otherwise.
- H. Overhead Stops:
 1. Provide overhead stop when corrosion resistant closer is specified.
 2. Provide concealed overhead stop on doors scheduled to receive closer mounted on pull side of door.
 3. Provide at interior doors not scheduled to receive a closer as follows:
 - a. Doors that swing more than 105 DEG without encountering a wall or obstruction.
 - 1) Stop shall limit swing of door from impacting wall or obstruction.
 - b. Inactive leaves of pairs of doors.

- I. Wall Mount Door Stops:
 - 1. Provide where specifically indicated on Hardware Schedule and at doors not otherwise indicated to receive:
 - a. Overhead stop.
 - b. Closer with integral stop.
- J. Floor mounted stops are not acceptable unless noted otherwise in this Specification Section.
- K. Install astragal on all pairs of UL labeled fire doors.
- L. Provide silencers for door frames.
 - 1. Fiberglass door frames: See Specification Section 08 16 13.
- M. Provide weather seal, door sweep and threshold at all doors.
 - 1. Set thresholds in a full bed of sealant.
 - 2. Mount door sweeps on exterior face of door.
 - 3. Mount weather seal astragal at meeting edges of pairs of doors on the exterior face of the doors.
- N. Provide smoke seals on all fire rated doors.
- O. Mount kickplates on both sides of doors.

3.2 FIELD QUALITY CONTROL

- A. Adjust and check each operating item of hardware to assure proper operation or function.
 - 1. Lubricate moving parts with lubricant recommended by manufacturer.
- B. During week prior to startup, make a final check and adjustment of all hardware items.
 - 1. Clean and lubricate as necessary to assure proper function and operation.
 - 2. Adjust door control devices to compensate for operation of heating and ventilating equipment.
- C. Inspection and Testing:
 - 1. AHC shall inspect and test all door assemblies and provide written certification that door assemblies are in proper working order.
 - a. Door assemblies required to swing in the direction of egress shall be inspected and tested in accordance with NFPA 101.
 - 2. Submit documentation and certification of testing in accordance with the certifications paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.

3.3 SCHEDULES

- A. Hardware Schedule:

HARDWARE SCHEDULE			
Hardware Set	Quantity	Unit	Description
HW-1	2	EA	Kickplate
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep

HARDWARE SCHEDULE			
Hardware Set	Quantity	Unit	Description
HW-2	3	EA	5-Knuckle Full Mortise Butt Hinge
	1	EA	T2 Exit Device – Storeroom Function
	1	EA	Closer w/Stop – Push Side Mounted
	2	EA	Kickplate
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep
	1	EA	Top of Door Flush Bolt – Inactive Leaf
HW-3	3	EA	5-Knuckle Full Mortise Butt Hinge
	2	EA	Kickplate
	1	EA	T1 Exit Device – Storeroom Function
	1	EA	Closer w/Stop – Push Side Mounted
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep

END OF SECTION

SECTION 08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Louvers and vents.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 62 00 - Flashing and Sheet Metal.
 - 4. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
 - 2. Air Movement and Control Association (AMCA).
 - 3. ASTM International (ASTM):
 - a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 DEFINITIONS

- A. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by Engineer.
- B. Factory applied high performance organic coatings utilizing PVDF resins shall be provided with manufacturer's standard 10-year warranty against color fade, chalking and film integrity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Louvers:
 - a. Airolite Company LLC.
 - b. Construction Specialties, Inc.
 - c. Ruskin Company.
 - d. Industrial Louvers, Inc.
 - e. American Warming and Ventilating.

f. Or equal.

2.2 MANUFACTURED UNITS

A. Louvers:

1. 4 IN deep.
2. Drainable with blades at 37-1/2 DEG.
3. Continuous blade appearance.
4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
5. Minimum free area: 8.58 SQFT for 4 x 4 FT louver.
6. Maximum pressure drop: 0.10 IN of water at 700 FPM.
7. Water penetration: 0.01 OZ/SQFT at 873 FPM.
8. AMCA certified.
9. Ruskin "ELF 375DX", or equal.
10. Insect screen:
 - a. 18-16 mesh aluminum.
 - b. Install in standard aluminum frame.
11. Bird screen:
 - a. 1/2 IN square mesh.
 - b. 16 GA aluminum.
 - c. Install in standard frame.

B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.

C. Finish:

1. Meet requirements of AAMA 2605.
 - a. PVDF coating with minimum 70 PCT resin content.
 - b. Color: To be selected by Engineer.

D. Size: Refer to Mechanical Drawings for louver size, and refer to Architectural Drawings for louver shapes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchoring and bracing accessories as required.
- C. Seal around perimeter on exterior and interior.
 1. See Section 07 92 00.
- D. Install 0.040 IN aluminum flashing at sill to match louver.
 1. See Section 07 62 00.

END OF SECTION



DIVISION 09

FINISHES



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FSECTION 09 96 00
HIGH PERFORMANCE INDUSTRIAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. High performance industrial coatings (HPIC).
 2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
 3. Minimum surface preparation requirements.
- B. Related Specification Sections include but are not necessarily limited to:
1. Section 01 61 03 - Equipment - Basic Requirements.
 2. Section 01 73 20 - Openings and Penetrations in Construction.
 3. Section 03 15 19 - Anchorage to Concrete.
 4. Section 03 41 33 - Precast and Prestressed Concrete.
 5. Section 05 50 00 - Metal Fabrications.
 6. Section 07 62 00 - Flashing and Sheet Metal.
 7. Section 07 92 00 - Joint Sealants.
 8. Section 08 16 13 - Fiberglass Doors.
 9. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
 10. Division 26 - Electrical.
 11. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 12. Section 40 05 07 - Pipe Support Systems.
 13. Section 40 05 51 - Valves - Basic Requirements.
 14. Section 41 22 23 - Hoists, Trolleys, and Monorails.
 15. Section 43 21 00 - Pumping Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American National Standards Institute/Steel Door Institute (ANSI/SDI):
 - a. A250.10, Test Procedure and Acceptance Criteria For Prime Painted Steel Surfaces for Steel Doors and Frames.
 2. ASTM International (ASTM):
 - a. B499, Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.
 - b. D3359, Standard Test Methods for Rating Adhesion by Tape Test.
 - c. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - d. D4259, Standard Practice for Abrading Concrete.
 - e. D4261, Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
 - f. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - g. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - h. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
 - i. D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - j. D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.
 - k. D6677, Standard Test Method for Evaluating Adhesion by Knife.

- l. D7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
 - m. D7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
 - n. E337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
 - o. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - p. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
3. Environmental Protection Agency (EPA).
 4. International Concrete Repair Institute (ICRI):
 - a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
 5. NACE International (NACE).
 6. National Association of Pipe Fabricators (NAPF):
 - a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings:
 - 1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
 - 2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
 7. NSF International (NSF).
 - a. 61, Drinking Water System Components - Health Effects.
 8. The Society for Protective Coatings (SSPC):
 - a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - b. SP 1, Solvent Cleaning.
 - c. SP 2, Hand Tool Cleaning.
 - d. SP 3, Power Tool Cleaning.
 - e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
 9. The Society for Protective Coatings/ NACE International (SSPC/ NACE):
 - a. SP 5/ NACE No. 1, White Metal Blast Cleaning
 - b. SP 6/ NACE No. 3, Commercial Blast Cleaning.
 - c. SP 7/ NACE No. 4, Brush-off Blast Cleaning.
 - d. SP 10/ NACE No. 2, Near-White Blast Cleaning.
 - e. SP 13/ NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
1. Coating manufacturer's technical representative shall be a NACE Certified Coatings Inspector, Level 3 minimum.
 2. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
 - a. Provide references for minimum of three different projects completed in last five years with similar scope of work.
 - b. Include name and address of project, size of project in value (coating) and contact person.
 3. NACE inspector shall be NACE Certified Coatings Inspector Level 3 minimum and shall have minimum of five years of experience of conducting inspections and tests as indicated in this Specification Section.
- C. Mock-Ups:
1. Construct sample floor areas demonstrating varying degree of slip resistance for Engineer review and acceptance.
 - a. Provide one sample of each texture of slip resistant material for Engineer's selection.
 - b. Size: minimum 2 feet by 2 feet each.

2. If not acceptable, construct additional sample floor areas as required.
 - a. After sample floor area is accepted destroy all other sample floor areas not accepted.
 3. Accepted sample floor area shall constitute minimum standard of quality for actual construction.
 4. Maintain sample floor area during construction and protect from damage.
 5. Subject to approval by Engineer, approved sample may be incorporated into the Work.
- D. Miscellaneous:
1. Furnish coating through one manufacturer unless noted otherwise.
- E. Deviation from specified MIL thickness or product type is not allowed without written authorization of Engineer.
- F. Material shall not be thinned unless approved, in writing, by coating manufacturer's technical representative.

1.3 DEFINITIONS

- A. Applicator:
1. Applicator is the person actually installing or applying the product in the field, at the Project site, or at an approved shop facility.
- B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 01 61 03.
- C. Appurtenant Surface: Accessory or auxiliary surface attached to or adjacent to a surface indicated to be coated.
- D. Corrosive Environment:
1. Immersion in or subject to:
 - a. Condensation, spillage or splash of a corrosive material such as water, wastewater or chemical solution.
 - b. Exposure to corrosive caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
 - c. For purposes of this Specification Section, corrosive environments include:
 - 1) Outdoor areas not otherwise identified as highly corrosive.
 - 2) Piping galleries.
 - 3) Surfaces within 2 feet of high water level.
- E. Outdoor Atmosphere or Surface: Outdoor atmosphere or surface exposed to weather and/or direct sunlight.
- F. Finished Area: A room or area that is listed in or has finish called for on Room Finish Schedule or is indicated on Drawings to be coated.
- G. Holiday:
1. A void, crack, thin spot, foreign inclusion, or contamination in the coating that significantly lowers the dielectric strength of the coating.
 2. May also be identified as a discontinuity or pinhole.
- H. HPIC: High performance industrial coatings.
1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.
- I. Indoor Atmosphere or Surface: Indoor atmosphere or surface not exposed to weather and/or direct sunlight.
- J. Immersion Service:
1. Any surface immersed in water or some other liquid.
 2. Surface of any pipe, valve, or any other component of the piping system subject to frequent wetting.
 3. Surfaces within two feet above high water level in water bearing structures.

- K. Piping System: Pipe, valves, fittings and accessories.
- L. Surface Hidden from View:
 - 1. Within pipe chases.
 - 2. Between top side of ceilings and underside of floor or roof structures above.
- M. Vapor Space: Interior space within tankage, closed structures, or similar elements that is above the low liquid line and subject to the accumulation of fumes, vapor and/or condensation.

1.4 SUBMITTALS

- A. Certifications:
 - 1. Applicator experience qualifications.
 - a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
 - 2. NACE inspector certification.
 - 3. NACE inspector experience qualifications.
 - 4. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by a NACE Certified Coatings Inspector employed by the coating manufacturer.
 - a. Submittals not including this certification will be returned without review.
- B. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's surface preparation instructions.
 - c. Manufacturer's application instructions.
 - 1) Manufacturer's standard details, including but not limited to penetrations, transitions, and terminations for:
 - a) High-build coatings on concrete.
 - b) Other special conditions as applicable.
 - d. If products being used are manufactured by Company other than listed in the MATERIALS Article of this Specification Section, provide complete individual data sheet comparison of proposed products with specified products including:
 - 1) Application procedure.
 - 2) Coverage rates.
 - 3) Certification that product is designed for intended use and is equal or superior to specified product.
 - e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.
 - f. Coating manufacturer's recommendation on abrasive blasting.
 - g. Coating manufacturer's technical representative's written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
 - h. Manufacturer's recommendation for universal barrier coat.
 - i. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.
 - 2. Manufacturer's statement regarding applicator instruction on product use.
- C. Samples:
 - 1. Manufacturer's full line of colors for Engineer's preliminary color selection.
 - 2. After preliminary color selection by Engineer provide two, 3 x 5 inches samples of each final color selected.
- D. Informational Submittals:
 - 1. Approval of application equipment.
 - 2. Applicator's daily records:

- a. Submit daily records at end of each week in which coating work is performed unless requested otherwise by Engineer's on-site representative.

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.
- B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1.6 PROJECT CONDITIONS

- A. Pre-application Conference:
 1. Prior to commencement of surface preparation or coating application, the Contractor shall convene a pre-application conference with all affected parties, including but not limited to: the applicator, coating manufacturer's technical representative, Owner's representative, and Engineer's representative(s).
 2. The meeting shall discuss all aspects of the Project including but not limited to:
 - a. Schedule.
 - b. Material storage and handling.
 - c. Examination of surfaces to be coated.
 - d. Protection of surfaces not to be coated.
 - e. Surface preparation.
 - f. Coating application:
 - 1) Environmental conditions for application of coatings.
 - 2) Temporary environmental controls.
 - g. Field quality control requirements:
 - 1) Manufacturer's technical representative responsibilities.
 - 2) Contractor performed testing.
 - a) Instrumentation requirements.
 - b) Frequency of testing.
 - c) Record keeping.
 - 3) NACE inspector performed testing.
- B. Verify that atmosphere in area where coating is to take place is within coating manufacturer's acceptable temperature, humidity and sun exposure limits.
 1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
 - a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by coating manufacturer.
 - b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 hour basis.
 - 1) Vent exhaust gases to outdoor environment.
 - 2) No exhaust gases shall be allowed to vent into the space being coated or any adjacent space.
 2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. High Performance Industrial Coatings:
 - a. Carboline Protective Coatings.
 - b. PPG.
 - c. The Sherwin-Williams Company.
 - d. Tnemec.
 - e. AkzoNobel.
- B. "Or-Equal" Submittals:
 1. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the manufacturers listed.
 2. Provide satisfactory documentation from the proposed "or-equal" manufacturer that proposed materials meets or exceeds the following:
 - a. Is of the same generic resin.
 - b. Requires comparable surface preparation.
 - c. Has comparable application requirements.
 - d. Meets the same VOC levels or better.
 - e. Provides the same finish and color options.
 - f. Is suitable for the intended service.
 - g. Resistance to abrasion and physical damage.
 - h. Resistance to chemical attack.
 - i. Resistance to UV exposure.
 - j. Ability to recoat in future.
 - k. Dry film thickness per coat.
 - 1) Where manufacturer's product data sheet indicates a minimum MIL thickness per coat that is greater than specified herein, MIL thickness for entire coating system shall be increased proportionately.
 - l. Minimum and Maximum time between coats.
 - m. Compatibility with other coatings.
 - n. Temperature limitations in service and during application.
 - o. Type and quality of recommended undercoats and topcoats.
 - p. Ease of application.
 - q. Ease of repairing damaged areas.
 - r. Stability of colors.
 3. The cost of all testing and analyzing of the proposed substitute materials shall be borne by the CONTRACTOR.

2.2 MATERIALS

- A. Coatings used for indoor finishes shall meet the requirements of the building code and NFPA 101.
 1. Wall and ceiling finishes: ASTM E84 or ANSI/UL 723.
 - a. Class A: Flame spread index 25 or less; smoke-developed index 450 or less.
 2. Indoor floor finishes: NFPA 253 or ASTM E648.
 - a. Class II: Critical radiant flux not less than 0.22W/CM² but less than 0.45W/CM².
- B. Coatings shall comply with the VOC limits of EPA.
- C. For unspecified materials such as thinner, provide manufacturer's recommended products.
- D. High Performance Industrial Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
AAE	Acrylic/Acrylate Emulsion	Series 180 WB Tneme-Crete	Cement Plex 875

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
AREC	Abrasion-Resistant Epoxy Coating	Series 435 Perma-Glaze	Duraplate 5900
AAP	Aliphatic Acrylic Polyurethane	Series 1095 Endurashield	Acrolon Ultra
EBF	Epoxy Block Filler	Series 1254 Epoxoblock WB	Kem Cati Coat HS
ESF	Epoxy Surfacer/Filler	Series 215 Surfacing Epoxy	Steel Seam FT 910
EMM	Epoxy Modified Cementitious Mortar	Series 218 MortarClad	Duraplate 2300
EF	Epoxy Flooring	Series 237 Power-Tread	GP3746
HREM	H2S-Resistant Epoxy Mortar	Series 434 Perma-Shield H ₂ S	Duraplate 5900 Mortar
MPE	Multi-Purpose Epoxy	Series N69 Hi-Build Epoxoline II	Macropoxy 646
STEP	Surface-Tolerant Epoxy Primer	Series 135 Chembuild	Macropoxy 646
UHSE	Ultra-High Solids Epoxy (NSF 61)	Series 22 Epoxoline	Duraplate UHS
ZRU	Zinc-Rich Urethane	Series 94-H ₂ O Hydro- Zinc	Corothane 1 Galvapak

2.3 COATING SYSTEMS:

- A. The following tables indicate coating systems by material and environment unless a specific application is indicated.
- B. Ferrous Metals (Structural and Miscellaneous Metals):

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	SSPC-SP 6/ NACE No. 3	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Indoor atmospheric (corrosive environment)	SSPC-SP 10/ NACE No. 2, min. 2 mil anchor profile	2.5 to 3.5 mil ZRU	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2 min. 3 mil anchor profile	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Outdoor atmospheric	SSPC-SP 6/ NACE No. 3	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

C. Galvanized Steel:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	SSPC-SP 16	4.0 to 6.0 mil STEP		2.0 to 3.0 mil MPE
Immersion - non NSF	SSPC-SP 16	4.0 to 6.0 mil STEP	2.0 to 3.0 mil MPE	2.0 to 3.0 mil MPE
Outdoor atmospheric	SSPC-SP 16	4.0 to 6.0 mil STEP		2.5 to 3.5 mil AAP
Field cut pipe threads	SSPC-SP 3	4.0 to 6.0 mil STEP	Coat per exposure above	Coat per exposure above

D. Non Ferrous Metals, including piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Dissimilar Materials Protection	SSPC-SP 2	4.5 to 5.5 mil MPE		
Indoor atmospheric	SSPC-SP 2	3.0 to 4.0 mil MPE		3.0 to 4.0 mil MPE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 16			40 to 45 MIL AREC
Immersion - non NSF	SSPC-SP 16	3.0 to 4.0 mil MPE		5.0 to 6.0 mil MPE
Outdoor atmospheric	SSPC-SP 2	4.0 to 6.0 mil MPE		2.5 to 3.5 mil AAP

E. Ferrous Piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 mil ZRU	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2, min 3 mil anchor profile	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	SSPC-SP 5/ NACE No.1	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Outdoor atmospheric	SSPC-SP 6/ NACE No. 3	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

F. Ductile Iron Piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Immersion - Wastewater (abrasion resistant)	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Outdoor atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

G. Concrete:

1. For repair of deteriorated existing concrete, provide additional surface preparation as specified in PREPARATION article in this Specification Section.

Environment/ Application	Surface Preparation	Filler/Surfer	Prime Coat	Intermediate Coat(s)	Finish Coat
Walls, ceilings, and appurtenant surfaces Indoor atmospheric	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	100 to 150 square feet/GAL MPE		100 to 150 square feet/GAL MPE
Indoor floors	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF as necessary to fill holes and depressions	175 to 225 square feet/GAL EF clear	200 to 250 square feet/GAL EF pigmented	200 to 250 square feet/GAL EF pigmented
Indoor Safety Striping	SSPC-SP 13/ NACE No. 6 ICRI CSP 3	ESF and/or EMM as necessary to fill holes and depressions			6.0 to 8.0 mil EF Pigmented
Immersion - non NSF	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 inches EMM			16 to 20 mil UHSE
Immersion - Wastewater (Abrasion Resistant)	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 inches EMM	1/8 inches HREM		15 to 25 mil AREC
Outdoor atmospheric Corrosive Environment	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	150 to 175 square feet/GAL AAE		150 to 175 square feet/GAL AAE

H. Concrete Masonry:

1. Coverage rates indicated are based on smooth-face normal weight CMU.
2. Provide increased coverage rates in accordance with manufacturer's recommendations for more porous surfaces.

Environment/ Application	Surface Preparation	Filler/Surface	Prime Coat	Intermediate Coat(s)	Finish Coat
Indoor atmospheric	Refer to PART 3	100 to 150 square feet/Gal EBF	75 to 100 square feet/Gal MPE		75 to 100 square feet/Gal MPE

PART 3 - EXECUTION

3.1 ITEMS TO BE COATED

- A. Outdoor Surfaces, including but not limited to:
 1. Concrete:
 - a. Concrete floors in Blower Buildings.
 - 1) Coat new floors to match existing floor coating color.
 - 2) Repair and recoat any surfaces damaged while performing the Work.
 2. Concrete masonry:
 - a. Interior walls in Blower Building.
 - 1) Coat new walls to match existing interior coating color.
 - 2) Repair and recoat any surfaces damaged while performing the Work.
 - b. Additional locations as indicated on Drawings.
 3. Piping, valves, fittings, hydrants and supports:
 - a. As scheduled in Specification Section 40 05 00.
 - b. Process piping scheduled to be insulated.
 4. Structural steel:
 - a. Columns, beams and bracing.
 - b. Field welded connections of factory coated structural steel.
 5. Miscellaneous ferrous metal surfaces:
 - a. Items specifically noted on Drawings to be coated.
 6. Miscellaneous galvanized steel surfaces:
 - a. Embed Plates.
 - b. Loose lintels.
 - c. Steel components of concrete lintels.
 - d. Items specifically noted on Drawings to be coated.
 7. Doors and frames:
 - a. Hollow metal doors and frames.
 8. Appurtenant surfaces attached to or adjacent to a surface indicated to be coated:
 - a. Conduit, boxes, covers and supports.
- B. Indoor Areas:
 1. Refer to Room Finish Schedule on Drawings.
 - a. If space is scheduled to be coated, coat all appurtenant surfaces within the space unless specifically noted otherwise. Appurtenant surfaces include but are not limited to:
 - 1) Columns.
 - 2) Equipment pads.
 - 3) Equipment supports.
 - 4) Underside of roof or floor decks above:
 - a) Including semi-exposed or concealed from view unless noted otherwise.
 - 5) Conduit, boxes, covers and supports.
 - 6) Miscellaneous ferrous metal surfaces.

2. Concrete masonry.
3. Piping, valves, fittings, hydrants and supports:
 - a. Do not coat piping scheduled to be insulated.
4. Ferrous metal process equipment.
 - a. Items specifically noted on Drawings to be coated.
5. Miscellaneous galvanized steel surfaces:
 - a. Pipe Bollards.
 - b. Embed Plates.
 - c. Loose lintels.
 - d. Steel components of concrete lintels.
 - e. Seismic angles at masonry partitions.
 - f. Items specifically noted on Drawings to be coated.
6. Safety Striping:
 - a. Equipment Pads: Coat as shown on Drawings.

3.2 ITEMS NOT TO BE COATED

- A. General: Do not coat items listed in this Article, unless noted otherwise.
- B. Items with Approved Factory Finish: These items may require repair of damaged coated areas or coating of welded connections.
- C. Electrical Equipment.
- D. Moving parts of mechanical and electrical units where coating would interfere with the operation of the unit.
- E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.
- F. Contact surfaces of friction-type structural connections.
- G. Stainless Steel Surfaces, except:
 1. Dissimilar metals in immersion service.
 2. Piping where specifically noted to be coated.
 3. Banding as required to identify piping.
- H. Aluminum Surfaces, except:
 1. Where specifically shown in the Contract Documents.
 2. Where in contact with concrete.
 3. Where in contact with dissimilar metals.
 4. Appurtenant surfaces as described in the ITEMS TO BE COATED article.
- I. Mechanical piping scheduled to be insulated.
- J. Interior of Pipe, Ductwork, and Conduits.
 1. See Division 23 for ductwork.
 2. See Division 40 for pipe linings.
- K. Galvanized Steel Items, unless specifically noted to be coated.
- L. Architectural Finishes:
 1. Outdoor concrete indicated to receive another finish.
 2. Precast concrete surfaces, unless specifically indicated to be coated.
 3. Prefinished masonry surfaces:
 - a. Pre-colored masonry (outdoor face).
 - 1) Interior face shall be coated where scheduled.
 - b. Burnished (ground face) concrete masonry.
 - c. Prefaced masonry.
 - d. Face brick.
 - e. Glass masonry.

4. Plastic laminate.
5. Solid surface material.
6. Standing and running trim.
7. Fiberglass fabrications.
8. Anodized aluminum.
9. PVDF coated metals.
10. Factory finished doors and frames.
11. Aluminum windows, curtainwall and storefront framing systems.
12. Finish hardware.
13. Glass and glazing.
14. Ceramic, porcelain, quarry tile or natural stone.
15. Acoustical materials.
16. Building specialties.
17. Louvers.
18. Casework and countertops.
19. Pipe insulation and jacketing.
20. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 EXAMINATION

A. Concrete:

1. Test pH of surface to be coated in accordance with ASTM D4262.
 - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
 - b. Retest pH until acceptable results are obtained.
2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
 - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
 - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869 or ASTM F2170.
 - 2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
 - 3) Retest surface until acceptable results are obtained.

B. Concrete Unit Masonry:

1. Test pH of surface to be coated in accordance with ASTM D4262.
 - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable limits.
 - b. Retest pH until acceptable results are obtained.
2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
 - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
 - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
 - 2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
 - 3) Retest surface until acceptable results are obtained.

3.4 PREPARATION

A. General:

1. Prepare surfaces to be coated in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.

- a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent surface preparation shall be provided unless approved otherwise, in writing, by the Engineer.
 2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
 3. Adhere to manufacturer's recoat time surface preparation requirements.
 - a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
 - 1) Minimum SSPC-SP 7/ NACE No. 4 unless otherwise approved by Engineer.
- B. Obtain samples of existing coating and have samples tested by a recognized testing laboratory to determine if existing coating contains lead, asbestos or any other health hazard as defined by the EPA.
 1. If existing coating is found to contain lead, asbestos, or any other health hazard, notify the Engineer immediately.
 2. Prepare plan of action for safe, legal removal and disposal of contaminated coating.
 3. Engineer, Contractor and Owner shall negotiate agreement for cost associated with removal.
- C. 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 code labels, equipment identification or rating plates and similar labels, tagging and identification.
- D. Prepare and coat before assembly all surfaces which are inaccessible after assembly.
- E. Ferrous Metal:
 1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and NAPP.
 - a. All piping, pumps, valves, fittings and any other component used in the water piping system that requires preparation for coating shall be prepared in accordance with requirements for immersion service.
 - b. Prepare all areas requiring patch coating in accordance with recommendations of manufacturer and NAPP.
 - c. Remove bituminous coating per piping manufacturer, coating manufacturer and NAPP recommendations.
 - 1) The most stringent recommendations shall apply.
 2. 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.
 3. Solvent clean in accordance with SSPC-SP 1.
 4. Restore surface of field welds and adjacent areas to original surface preparation.
- F. Galvanized Steel and Non-ferrous Metals:
 1. Solvent clean in accordance with SSPC-SP 1 followed by brush-off blast clean in accordance with SSPC-SP 16 to remove zinc oxide and other foreign contaminants.
 - a. Provide uniform 1 mil profile surface.
- G. Hollow Metal Doors and Frames:
 1. Verify factory-applied prime coat is in accordance with ANSI/SDI A250.10.
 2. Prepare as indicated in COATING SYSTEMS Article.
- H. Concrete:
 1. Cure for minimum of 28 days.
 2. Concrete surfaces shall be cleaned in accordance with ASTM D4258.

3. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC-SP 13/ NACE No. 6.
 - a. Provide profile per ICRI 301.2 as listed in MATERIALS article of this Specification Section.
 4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.
- I. Concrete Masonry:
1. Cure for minimum of 28 days.
 2. Remove all mortar spatters and protrusions.
 3. Clean concrete masonry in accordance with Specification ASTM D4261.
 4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.
- J. Preparation by Abrasive Blasting:
1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before coating.
 2. Provide compressed air for blasting that is free of water and oil.
 - a. Provide accessible separators and traps.
 3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
 4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of coatings.
 - a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
 5. Perform additional blasting and cleaning as required to achieve surface preparation required.
 - a. Re-blast surfaces not meeting requirements of these Specifications.
 - b. Prior to coating, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
 - c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to coating shall be re-inspected prior to coating application.
 6. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
 7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in coating.
 8. Confine blast abrasives to area being blasted.
 - a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
 - b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
 9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
 10. Properly dispose of blasting material contaminated with debris from blasting operation.
- K. All Plastic Surfaces:
1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.5 APPLICATION

- A. General:
1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
 - a. Application equipment must be inspected and approved in writing by coating manufacturer.
 2. Temperature and weather conditions:

- a. Do not coat surfaces when surface temperature is below 50 degrees F unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and coating manufacturer's technical representative.
 - b. Avoid coating surfaces exposed to hot sun.
 - c. Do not coat damp surfaces.
 - d. Apply coating to concrete or masonry surfaces in descending temperatures, in accordance with coating manufacturer's application instructions.
3. Apply materials under adequate illumination.
 4. Provide complete coverage to MIL thickness specified.
 - a. Thickness specified is dry MIL thickness.
 5. Evenly spread to provide full, smooth coverage.
 - a. All coating systems are "to cover."
 - 1) In situations of discrepancy between manufacturer's square footage coverage rates and MIL thickness, MIL thickness requirements govern.
 - b. When color or undercoats show through, apply additional coats until coating is of uniform finish and color.
 - c. Finished coating system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
 6. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
 7. Work each application of material into corners, crevices, joints, and other difficult to work areas.
 8. Provide coating manufacturer's recommended details at all terminations, penetrations, embedments, cracks, joints and changes in substrate direction.
 9. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
 - a. Clean contaminated surfaces before applying next coat.
 - b. Intercoat surface cleanliness shall be inspected and approved by the Engineer prior to application of each coat.
 10. Smooth out runs or sags immediately, or remove and recoat entire surface.
 11. Allow preceding coats to dry before recoating.
 - a. Recoat within time limits specified by coating manufacturer.
 - b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
 12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
 13. Coat all aluminum in contact with dissimilar materials.
 14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses provided that the maximum DFT is not exceeded.
 15. Backroll surfaces if coatings are spray applied.
- B. Employ services of coating manufacturer's technical representative to ensure that field-applied coatings are compatible with factory-applied or existing coatings.
1. Certify through material data sheets.
 2. Perform test patch.
 - a. Prepare existing coating surface to receive specified coating system.
 - b. Apply coating to a minimum 1 square feet area and allow to cure in accordance with manufacturer's recommendations.
 - c. Evaluate adhesion to existing coating:
 - 1) Concrete or Masonry substrates: ASTM D4541.
 - 2) All other substrates: ASTM D6677 and ASTM D3359 (X-cut method).
 3. 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.
 - a. Perform test patch as described above.

4. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate coating system listed in the MATERIALS Article, Coating Systems paragraph of this Specification Section.
 - a. 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.

C. Prime Coat Application:

1. Apply structural steel and miscellaneous steel prime coat in the factory.
 - a. Finish coats shall be applied in the Shop.
 - b. Prime coat referred to here is prime coat as indicated in this Specification.
 - 1) Prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
 - c. Application of all factory-applied coatings(s) on structural steel and miscellaneous steel shall be continually observed and certified by NACE coatings inspector.
2. Prime all surfaces indicated to be coated.
 - a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
3. Prime ferrous metals embedded in concrete to minimum of 1 inch below exposed surfaces.
4. Apply zinc-rich primers while under continuous agitation.
5. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
6. Touch up damaged primer coats prior to applying finish coats.
 - a. Restore primed surface equal to surface before damage.
7. All surfaces of steel lintels and steel components of concrete lintels used in wall construction shall be completely coated with both prime and finish coats prior to placing in wall.

D. Finish Coat Application:

1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
2. Touch up damaged finish coats using same application method and same material specified for finish coat.
 - a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.

3.6 COLOR CODING

- A. Color code piping in accordance with the SCHEDULE Article of this Specification Section.

3.7 FIELD QUALITY CONTROL

A. Application Deficiencies:

1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.
 - a. Epoxy surfaces showing evidence of chalking or amine blush shall be prepared and recoated as follows:
 - 1) Solvent clean surfaces in accordance with SSPC-SP1 and abrasive blast in accordance with SSPC-SP7/ NACE No. 4.
 - 2) Recoat with intermediate and finish coats in accordance with coating system specified herein.

B. Provide protection for coated surfaces.

1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.

C. Contractor Performed Testing:

1. Provide ongoing testing and inspection, including but not limited to the following:
 - a. Measurement and recording of environmental conditions as specified herein.
 - b. Measurement and recording of substrate conditions as specified herein.
 - c. Thickness Testing:
 - 1) Wet film thickness during application in accordance with ASTM D4414.
 - 2) Dry Film Thickness (DFT) in accordance with SSPC-PA 2.
 - 3) Engineer may measure coating thickness at any time during project to assure conformance with these Specifications.
 - d. Bond Strength:
 - 1) Bond strength testing will be required by the Owner where there is reason to suspect the integrity of the coating system.
 - 2) Measure bond strength of the coating in accordance with:
 - a) Steel substrate: ASTM D4541.
 - b) Concrete substrate ASTM D7234.
 - 3) The number of test sites and locations to be tested shall be determined by the Owner after application of coating. The Contractor will apply the dollies, perform the tests and repair the coating in the presence of the Owner.
 - a) For each test that fails, two additional tests shall be performed in the adjacent area.
 - b) Further bond tests may be performed to determine the extent of potentially deficient bonded areas at no additional cost to the Owner.
 - 4) Repairs shall be made by applicator in strict accordance with manufacturer's recommendations. Any coated areas that do not pass the bond strength tests shall be removed and replaced at the expense of the Contractor.

D. NACE inspection:

1. The Owner reserves the right to retain a NACE Level 3 coating inspector to perform observation, inspection and testing as deemed necessary to document the quality of the Work.
 - a. All work shall be done to the satisfaction of the Owner's inspector.
 - b. Any portion of the coating that does not satisfactorily pass the inspection and testing requirements shall be repaired or replaced by the Contractor at no additional cost to the Owner.
 - c. Additional testing and/or inspection may be done at the discretion of the Owner.
 - 1) The Contractor will provide all equipment, materials, and labor to perform the testing.
2. Inspection, testing or observation by the Owner's inspector shall not relieve the Contractor of responsibility for surface preparation, inspection or quality control specified herein.

E. Instrumentation:

1. Provide instrumentation as necessary to measure and record atmospheric and substrate conditions, including but not limited to:
 - a. Dry Film Thickness Gauge:
 - 1) Ultrasonic: ASTM D6132.
 - 2) Magnetic: ASTM B499.
 - b. Wet Film Thickness Gauge: ASTM D4414.
 - c. Sling Psychrometer: ASTM E337.
 - d. Surface Temperature Gauge.
 - e. Anemometer.
 - f. Moisture Meter.
 - g. Adhesion test apparatus:
 - 1) Steel: ASTM D4541.
 - 2) Concrete: ASTM D7234.

F. Maintain Daily Records:

1. Record the following information during application:
 - a. Date, starting time, end time, and all breaks taken by applicators.
 - b. Air temperature.
 - c. Relative humidity.
 - d. Dew point.
 - e. Moisture content and pH level of concrete or masonry substrates prior to coating.
 - f. Surface temperature of substrate.
 - g. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind-blown dust and debris from contaminating the wet coating.
 - h. For outdoor coating, also record:
 - 1) Sky condition.
 - 2) Wind speed and direction.
 - i. Record environmental conditions, substrate moisture content and surface temperature information not less than once every 4 hours during application.
 - 1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.
2. Record the following information daily for the coating manufacturer's recommended curing period:
 - a. Date and start time of cure period for each item or area.
 - b. For outdoor coating, also record:
 - 1) Sky conditions.
 - 2) Wind speed and direction.
 - 3) Air temperature.
 - a) Dry Bulb.
 - b) Wet Bulb.
 - 4) Relative humidity.
 - 5) Dew point.
 - 6) Surface temperatures.
 - c. Record environmental conditions not less than once every 4 hours.
 - 1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.
 - d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
3. Format for daily record to be computer generated.

G. Provide wet paint signs.

3.8 CLEANING

- A. Clean coating spattered surfaces.
 1. Use care not to damage finished surfaces.
- B. Upon completion of coating, replace hardware, accessories, plates, fixtures, and similar items.
- C. Remove surplus materials, scaffolding, and debris.

3.9 COLOR SCHEDULE

- A. Pipe Bollards: Safety Yellow.
- B. Piping:
 1. Refer to Specification Section 10 14 00 for the piping system and banding material and refer to this Specification Section and this Schedule for the banding colors.
 2. Match existing piping and banding colors.

SERVICE	PIPE COLOR	BANDING COLOR
Wastewater Piping:		
Plant influent	Gray	Black
Settled final	Gray	Red
Filtered	Gray	International Orange/Black
Final effluent	Gray	International Orange/Brown
Plumbing drains	Gray	Safety Blue
Supernatant	Gray	Safety Green filtrate or centrate
Filter backwash	Gray	Safety Yellow
Sump	Gray	White
Sludge Piping:		
Waste activated	Brown	Gray/Black
Recirculated	Brown	Gray/Red waste activated
Digested or processed	Brown	International Orange/Black
Dewatered	Brown	Safety Blue/Black
Wasted	Brown	Safety Blue/Gray
Miscellaneous Sludge Piping:		
Scum	Dk. Brown	32GR-Gray
Grit	Dk. Brown	07SF-Red
Water Piping:		
Service	Safety Green	35GR-Black
Nonpotable	Safety Green	32GR-Gray
Make-up	Safety Green	Brown
Potable water hot	-	05SF-InternationalOrange
Cooling	Safety Green	11SF-Safety Blue
Condensate	Safety Green	35GR/32GR-Black/Gray
Potable water cold	-	35GR/07SF-Black/Red
Gas and Fuel Piping:		
Natural	Safety Yellow	Safety Red/Black
Diesel	Stainless Steel	
Air Low Pressure	Stainless Steel	White/Gray
Chemical Piping:		
Alum	White	Black/Gray
Cationic coagulant	White	Safety Green/Black/Brown

3.10 ROOM FINISH SCHEDULE

ROOM NO.	DWG NO.	ROOM NAME	FLOOR	BASE	WALLS	CEILING		REMARKS
						FIN	HT	
R-1	A-101	Blower Room	HPIC-x	None	HPIC-x	HPIC-x	HPIC-x	Match existing colors
R-2A	A-101	New Electrical Room	HPIC-x	None	HPIC-x	HPIC-x	HPIC-x	Match colors of existing blower room
R-2B	A-101	Repurposed Electrical Room	HPIC-x	None	HPIC-x	HPIC-x	HPIC-x	Match colors of existing blower room
REMARKS – N/A								
ROOM FINISH LEGEND								
FLOOR					BASE			
CPT-x	Carpet				None	None		
CS-x	Concrete Sealer				CPT-x	Carpet		
CT-x	Ceramic Tile				CT-x	Ceramic Tile		
EF-x	Epoxy Flooring				EF-x	Epoxy Flooring		
HPIC-x	High Performance Industrial Coating				RB-x	Resilient Base		
SV-x	Sheet Vinyl				SV-x	Sheet Vinyl		
VCT-x	Vinyl Composite Tile							
WALLS					CEILING			
None					ES	Exposed structure - No Paint		
AP-x	Architectural Paint				AP-x	Architectural Paint		
HPIC-x	High Performance Industrial Coating				HPIC-x	High Performance Industrial Coating		
SC-x	Special Coating				ACT-x	Acoustical Ceiling Tile		

END OF SECTION



DIVISION 10

SPECIALTIES



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SECTION 10 14 00
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items.
 - 2. Hazard and safety signs.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 01 61 03 - Equipment - Basic Requirements.
 - 2. Section 09 96 00 - High Performance Industrial Coatings.
 - 3. Section 10 14 23 - Signage.
 - 4. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.
 - 5. Section 40 90 00 - Instrumentation for Process Control Requirements - Basic Requirements.
 - 6. Section 40 94 43 - Programmable Logic Controller (PLC) Control System.
 - 7. Section 40 98 00 - Control Panels and Enclosures.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. A13.1, Scheme for the Identification of Piping Systems.
 - 2. The International Society of Automation (ISA).
 - 3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
 - a. Z535.1, Safety Color Code.
 - b. Z535.2, Environmental and Facility Safety Signs.
 - c. Z535.3, Criteria for Safety Symbols.
 - d. Z535.4, Product Safety Signs and Labels.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.
 - 5. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Catalog information for all identification systems.
 - b. Acknowledgement that products submitted meet requirements of standards referenced.
 - 2. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
 - 3. Schedule of Hazard and Safety Signage indicating text and graphics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. W.H. Brady Co.
2. Panduit.
3. Seton.
4. National Band and Tag Co.
5. Carlton Industries, Inc.

2.2 MANUFACTURED UNITS

- A. Type A1 - Round Metal Tags:
 1. Materials:
 - a. Aluminum or stainless steel.
 - b. Stainless steel shall be used in corrosive environments.
 2. Size:
 - a. Diameter: 1-1/2 inches minimum.
 - b. Thickness: 0.035 inches (20 GA) minimum.
 3. Fabrication:
 - a. 3/16 inches minimum mounting hole.
 - b. Legend: Stamped and filled with black coloring.
 4. Color: Natural.
- B. Type A2 - Rectangle Metal Tags:
 1. Materials: Stainless steel.
 2. Size:
 - a. 3-1/2 inches x 1-1/2 inches minimum.
 - b. Thickness: 0.036 inches (20 GA) minimum.
 3. Fabrication:
 - a. 3/16 inches minimum mounting hole.
 - b. Legend: Stamped and filled with black coloring.
 4. Color: Natural.
- C. Type A3 - Metal Tape Tags:
 1. Materials: Aluminum or stainless steel.
 2. Size:
 - a. Width 1/2 inches minimum.
 - b. Length as required by text.
 3. Fabrication:
 - a. 3/16 inches minimum mounting hole.
 - b. Legend: Embossed.
 4. Color: Natural.
- D. Type B1- Square Nonmetallic Tags:
 1. Materials: Fiberglass reinforced plastic.
 2. Size:
 - a. Surface: 2 x 2 inches minimum.
 - b. Thickness: 100 mils.
 3. Fabrication:
 - a. 3/16 inches mounting hole with metal eyelet.
 - b. Legend: Preprinted and permanently embedded and fade resistant.
 4. Color:
 - a. Background: Manufacturer standard or as specified.
 - b. Lettering: Black.
- E. Type B2 - Nonmetallic Signs:
 1. Materials: Fiberglass reinforced or durable plastic.
 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 60 mils minimum.
 3. Fabrication:

- a. Rounded corners.
 - b. Drilled holes in corners with grommets.
 - c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
 - 4. Color:
 - a. Background: Manufacturer standard or as specified.
 - b. Lettering: Black.
 - 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- F. Type C - Laminated Name Plates:
- 1. Materials: Phenolic or DR (high impact) acrylic.
 - 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 1/16 inches.
 - 3. Fabrication:
 - a. Outdoor rated and UV resistant when installed outdoors.
 - b. Two layers laminated.
 - c. Legend: Engraved through top lamination into bottom lamination.
 - d. Two drilled side holes, for screw mounting.
 - 4. Color: Black top surface, white core, unless otherwise indicated.
- G. Type D - Self-Adhesive Tape Tags and Signs:
- 1. Materials: Vinyl tape or vinyl cloth.
 - 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 5 mils minimum.
 - 3. Fabrication:
 - a. Indoor/Outdoor grade.
 - b. Weather and UV resistant inks.
 - c. Permanent adhesive.
 - d. Legend: Preprinted.
 - e. Wire markers to be self-laminating.
 - 4. Color: White with black lettering or as specified.
 - 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- H. Type E - Heat Shrinkable Tape Tags:
- 1. Materials: Polyolefin.
 - 2. Size: As required by text.
 - 3. Fabrication:
 - a. Legend: Preprinted.
 - 4. Color: White background, black printing.
- I. Type F - Underground Warning Tape:
- 1. Materials: Polyethylene.
 - 2. Size:
 - a. 6 inches wide (minimum).
 - b. Thickness: 3.5 mils.
 - 3. Fabrication:
 - a. Legend: Preprinted and permanently imbedded.
 - b. Message continuous printed.
 - c. Tensile strength: 1750 psi.
 - 4. Color: As specified.
- J. Type G - Stenciling System:
- 1. Materials:

- a. Exterior type stenciling enamel.
 - b. Either brushing grade or pressurized spray can form and grade.
 - 2. Size: As required.
 - 3. Fabrication:
 - a. Legend: As required.
 - 4. Color: Black or white for best contrast.
- K. Underground Tracer Wire:
- 1. Materials:
 - a. Wire:
 - 1) 12 GA AWG.
 - 2) Solid.
 - b. Wire nuts: Waterproof type.
 - c. Split bolts: Brass.

2.3 ACCESSORIES

- A. Fasteners:
- 1. Bead chain: #6 brass, aluminum or stainless steel.
 - 2. Plastic strap: Nylon, urethane or polypropylene.
 - 3. Screws: Self-tapping, stainless steel.
 - 4. Adhesive, solvent activated.

2.4 MAINTENANCE MATERIALS

- A. 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 GENERAL INSTALLATION

- A. Install identification devices at specified locations.
- B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
- C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.
- D. Attach tags with 1/8 inches round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
 - 1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.
- E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
 - 1. Several items of equipment mounted in housing to be individually tagged inside the compartment.
- F. Tracer Wire:
 - 1. Attach to pipe at a maximum of 10 feet intervals with tape or tie-wraps.
 - 2. Continuous pass from each valve box and above grade at each structure.
 - 3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
 - 4. 1,000 feet maximum spacing between valve boxes.
 - 5. If split bolts are used for splicing, wrap with electrical tape.
 - 6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 inches of wire for splicing.
 - 7. Use continuous strand of wire between valve box where possible.
 - a. Continuous length shall be no shorter than 100 feet.

3.2 SCHEDULES

- A. Hazard and Safety Signage:
 - 1. Miscellaneous OSHA hazard signage:
 - a. Tag Type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 10 inches x 14 inches.
 - d. Loc
 - e. Location: Field located as directed by Owner.
 - 1) Allowance: Provide 10 OSHA Danger, Caution, Safety Instruction or Biohazard signs as directed by Owner.
 - f. Legend:
 - 1) Description of hazard shall be determined by Owner.
 - 2) Provide international graphic symbology where indicated.
- B. Process Systems:
 - 1. General:
 - a. Provide arrows and markers on piping.
 - 1) At 20 feet 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 pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
 - b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
 - 1) If flow is in both directions use double headed arrow markers.
 - c. Apply tapes and stenciling in uniform manner parallel to piping.
 - d. Existing buried piping shall only require warning tape replacement if existing warning tape is uncovered. Contractor shall verify in field.
 - 2. Trenches with piping:
 - a. Tag type: Type F - Underground Warning Tape
 - b. Location: Halfway between top of piping and finished grade.
 - c. Letter height: 1-1/4 inches minimum.
 - d. Natural gas or digester gas:
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED GAS LINE BELOW"
 - e. Potable water:
 - 1) Color: Blue with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED WATER LINE BELOW"
 - f. Storm and sanitary sewer lines:
 - 1) Color: Green with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED SEWER LINE BELOW"
 - g. Nonpotable water piping, except 3 inches and smaller irrigation pipe:
 - 1) Color: Green with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED NONPOTABLE WATER LINE BELOW"
 - h. Chemical feed piping (e.g., chlorine solution, polymer solution, caustic solution, etc.):
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"

- b) Second line: “BURIED CHEMICAL LINE BELOW”
 - i. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, etc.):
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: “CAUTION CAUTION CAUTION”
 - b) Second line: “BURIED PIPE LINE BELOW”
- 3. Yard valves, buried, with valve box and concrete pad:
 - a. Tag type: Type A2 - Rectangle Metal Tags.
 - b. Fastener: 3/16 inches x 7/8 inches plastic screw anchor with 1 inch #6 stainless steel pan head screw.
 - c. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) Valve designation as indicated on the Drawings (e.g., “V-xxx”).
- 4. Valves and slide gates:
 - a. Tag type:
 - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
 - 2) Indoor noncorrosive:
 - a) Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - 3) Indoor corrosive:
 - a) Stainless steel Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - b. Fastener:
 - 1) Type A1: Chain of the same material.
 - 2) Type B1: Stainless steel chain.
 - c. Color: Per ASME A13.1 corresponding to the piping system.
 - d. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) Valve designation as indicated on the Drawings (e.g., “V-xxx”).
- 5. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Tags and Signs.
 - 3) Type G - Stenciling System.
 - b. Fastener:
 - 1) Self.
 - 2) Screws.
 - 3) Adhesive.
 - c. Legend:
 - 1) Letter height: 1/2 inches minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., “Primary Sludge Pump P-xxx”).
- 6. Piping systems:
 - a. Tag type:
 - 1) Outdoor locations: Type G - Stenciling System.
 - 2) Indoor locations:
 - a) Type D - Self-Adhesive Tape Tags and Signs.
 - b) Type G - Stenciling System.
 - b. Fastener: Self.
 - c. Color: Per ASME A13.1.
 - d. Legend:
 - 1) Letter height: Manufacturers standard for the pipe diameter.
 - 2) Mark piping in accordance with ASME A13.1.
 - 3) Use piping designation as indicated on the Drawings.

- 4) Arrow: Single arrow.
 - 7. Process tanks (over 1,000 GAL) and basins, (e.g., chemical storage, clarifiers, trickling filters, digesters, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener:
 - 1) Screw.
 - 2) Self.
 - c. Location as directed by Owner.
 - d. Legend:
 - 1) Letter height: 4 inches minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Clarifier CL-xxx").
 - 8. Tanks (less than 1,000 GAL) (e.g., break tanks, chemical tanks, hydro-pneumatic tanks, air receivers, etc.):
 - a. Tag type:
 - 1) Type D - Self-Adhesive Tape Tags and Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 2 inches minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Polymer Storage Tank Txxx")
 - 9. Equipment that starts automatically:
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener:
 - 1) Type B2 - Screw or adhesive.
 - 2) Type D - Self.
 - c. Size: 5 inches x 7 inches
 - d. Location: All equipment starts automatically. Location as indicated in Drawings.
 - e. Legend:
 - 1) OSHA Warning Sign.
 - 2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".
- C. Instrumentation Systems:
- 1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
 - a. Tag type:
 - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
 - 2) Indoor noncorrosive:
 - a) Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - 3) Indoor corrosive:
 - a) Stainless steel Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - b. Fastener:
 - 1) Type A1: Chain of the same material.
 - 2) Type B1: Stainless steel chain.
 - c. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").
 - 2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.

- c. Legend:
 - 1) Letter height: 1/2 inches minimum.
 - 2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
 - 3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 inches minimum.
 - 2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
 - 4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) Component ISA tag number as indicated on the Drawings (e.g., "HS-xxx").
- D. HVAC Systems:
- 1. General:
 - a. Provide arrows and markers on ducts.
 - 1) At 20 feet maximum centers along continuous lines.
 - 2) At changes in direction (route) or obstructions.
 - 3) At dampers, risers, branches, machinery or equipment.
 - 4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
 - b. Position markers on both sides of duct with arrow markers pointing in flow direction.
 - 1) If flow is in both directions use double headed arrow markers.
 - c. Apply tapes and stenciling in uniform manner parallel to ducts.
 - 2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1 inch minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
 - 3. Ductwork:
 - a. Tag type:
 - 1) Type D - Self-Adhesive Tape Tags and Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 1 inch minimum.
 - 2) Description of ductwork, (e.g., "AIR SUPPLY").
 - 3) Arrows: Single arrow.
 - 4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 inches minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").
 - 5. Wall mounted thermostats:
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.

- b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 inches minimum.
 - 2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").
 - 6. Components inside equipment enclosure, (e.g., controller's, control relays, contactors, and timers):
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 inches minimum.
 - 2) Description or function of component (e.g., "CR-xxx").
 - 7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
- E. Electrical Systems:
- 1. General:
 - a. Existing buried conduit, wire, and cable shall only require warning tape replacement if existing warning tape is uncovered. Contractor shall verify in field.
 - 2. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
 - a. Tag type: Type F - Underground Warning Tape.
 - b. Letter height: 1-1/4 inches minimum.
 - c. Location:
 - 1) Where trench is 12 inches or more below finished grade: In trench 6 inches below finished grade.
 - 2) Where trench is less than 12 inches below finished grade: In trench 3 inches below finished grade.
 - d. Electrical power (e.g., low and medium voltage):
 - 1) Color: Red with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION".
 - b) Second line: "BURIED ELECTRIC LINE BELOW".
 - e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
 - 1) Color: Orange with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION".
 - b) Second line: "BURIED COMMUNICATION LINE BELOW".
 - 3. Switchgear, switchboards and motor control centers:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Main equipment legend:
 - 1) Letter height:
 - a) First line: 1 inch minimum.
 - b) Subsequent lines: 3/8 inches minimum.
 - 2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSB-xxx").
 - 3) Second line:
 - a) Source of power (e.g., "FED FROM MCC-xxx LOCATED IN ROOM xxx").
 - b) Include the building name or number if the source is in another building.
 - 4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").

- d. Main and feeder device legend:
 - 1) Letter height: 3/8 inches minimum.
 - 2) Description of load (e.g., "MAIN DISCONNECT", "PUMP P-xxx" or "PANELBOARD HP-xxx").
- 4. Panelboards and transformers:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height:
 - a) First line: 3/8 inches minimum.
 - b) Subsequent lines: 3/16 inches minimum.
 - 2) First line: Equipment name (e.g., "PANELBOARD LP-xxx" or "TRANSFORMER T-xxx").
 - 3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").
 - 4) Third line:
 - a) Source of power (e.g., "FED FROM MCC-xxx LOCATED IN ROOM xxx").
 - b) Include the building name or number if the source is in another building.
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
- 5. Transfer switches:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height:
 - a) First line: 3/8 inches minimum.
 - b) Subsequent lines: 3/16 inches minimum.
 - 2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH ATS-xxx").
 - 3) Second line: Normal source of power (e.g., "NORMAL SOURCE FED FROM MCC-xxx").
 - 4) Third line: Emergency source of power (e.g., "EMERGENCY SOURCE FED FROM SGEN-xxx").
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
- 6. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) First line: Description of load equipment is connected to (e.g., "PUMP P-xxx").
 - 3) Second line:
 - a) Source of power (e.g., "FED FROM MCC-xxx LOCATED IN ROOM xxx").
 - b) The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
- 7. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 inches minimum.
 - 2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCP-xxx").
- 8. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:

- 1) Letter height: 3/16 inches minimum.
 - 2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
9. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 inches minimum.
 - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
 10. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Tag conductor at both ends.
 - d. Legend:
 - 1) Letter height: 1/8 inches minimum.
 - 2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
 11. Conductors in handholes and manholes.
 - a. Tag type: Type A3 - Metal Tape Tags.
 - b. Fastener: Nylon strap.
 - c. Tag conductor at both ends.
 - d. Legend:
 - 1) Letter height: 1/8 inches minimum.
 - 2) Circuit number or wire number as scheduled on the Drawings.
 12. Grounding conductors associated with grounding electrode system in accordance with the following:
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 1/8 inches minimum.
 - 2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
 13. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
 - a. Tag type: Type D - Self-Adhesive Tape Signs.
 - b. Fastener: Self.
 - c. Legend: Per NFPA 70.
 14. Entrances to electrical rooms:
 - a. Tag type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 5 inches x 7 inches.
 - d. Location: Each door to room.
 - e. Legend:
 - 1) OSHA Danger Sign.
 - 2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".
 15. Equipment where more than one voltage source is present:
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Signs.
 - b. Fastener:
 - 1) Screw or adhesive.
 - 2) Self.
 - c. Size: 1-3/4 inches x 2-1/2 inches.

- d. Location: Exterior face of enclosure or cubical.
- e. Legend:
 - 1) OSHA Danger Sign.
 - 2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

END OF SECTION

SECTION 10 14 23

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room identification signs.
 - 2. Other identification signs:
 - a. Fire and/or smoke barrier identification signs.
 - 3. Aluminum letters.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 2. ASTM International (ASTM):
 - a. B26, Standard Specification for Aluminum-Alloy Sand Castings.
 - 3. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.

1.3 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.
- B. Wet and/or Corrosive Areas: For the purposes of this Specification Section, the following rooms or areas are considered wet and/or corrosive:
 - 1. Pump rooms.
 - 2. Chemical storage rooms.
 - 3. Maintenance rooms.
 - 4. Process equipment rooms.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Color charts for Engineer's color selection.
 - 1) Color selection shall be made from manufacturer's complete color line including all premium and special colors.
 - 3. Schedule of all signs indicating text and graphics.
 - 4. Layout drawings of all signage showing size, letter style, text, border, finish, and installation detail.
 - a. Provide drawings for:
 - 1) Room identification signs.

- 2) Fire and/or smoke barrier identification signs.
 - 3) Aluminum letters.
- B. Samples:
1. Room identification signs.
 2. Fire and/or smoke barrier identification signs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Room, exit and stair identification signs:
 - a. ASE - Architectural Signs and Engraving.
 - b. ASI Signage Innovations.
 - c. Best Sign Systems.
 - d. Mohawk Sign Systems.
 - e. Nelson-Harkins.
 - f. Southwell Co.
 - g. Stamprite Supersine Identification Specialists.
 - h. Or equal.
 2. Fire and/or smoke barrier identification signs:
 - a. Brady.
 - b. Panduit.
 - c. Seton.
 - d. Carlton Industries.
 - e. Or equal.
 3. Aluminum letters:
 - a. A R K Ramos Manufacturing Co., Inc.
 - b. ASI Signage Innovations.
 - c. Leeds Architectural Letters.
 - d. Metal Arts.
 - e. Metallic Arts.
 - f. The Southwell Co.
 - g. Or equal.

2.2 MATERIALS

- A. Room , Exit, and Stair Identification Signs:
1. Interior:
 - a. Dry, non-corrosive areas: Melamine plastic suitable for raised lettering and Braille.
 - b. Wet and/or corrosive areas: Aluminum or fiberglass suitable for raised lettering and Braille.
 2. Exterior: Aluminum or fiberglass suitable for raised lettering and Braille.

2.3 FABRICATION

- A. Room Identification Signs:
1. General:
 - a. Raised text, border and graphics.
 - 1) Minimum 1/32 IN height.
 - 2) Provide international graphic symbology for all toilet, locker and shower rooms or combinations thereof, and for unisex toilet rooms and stairs.
 - 3) Provide handicap symbol on all signs for rooms meeting handicap requirements.
 - b. Grade 2 Braille.
 - c. Finish: Eggshell.

- 1) Color: To be selected.
 - d. Text:
 - 1) Typeface: Sans Serif.
 - 2) Size: Minimum 3/4 IN high.
 - e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
 - f. Exterior signs shall be rated for exterior use.
 - g. All signs shall comply with requirements of ADA.
- B. Fire and/or Smoke Barrier Identification Signs:
 - 1. Self-adhesive tape tags and signs:
 - a. Materials: Vinyl tape or vinyl cloth.
 - 1) Indoor/Outdoor grade.
 - 2) Weather and UV resistant inks.
 - 3) Permanent adhesive.
 - b. Size:
 - 1) Surface: As required by text.
 - 2) Thickness: 5 MILS minimum.
 - c. Color: White with black lettering.
 - 2. Typeface: Helvetica Medium.
 - 3. Text Size:
 - a. Height: 3 IN minimum.
 - b. Stroke: 3/8 IN minimum.
 - c. Text: As indicated in the SCHEDULES Article in PART 3Fabrication:
- C. Hazard Communication Signage (NFPA and OSHA signage): See Specification Section 10 14 00.
- D. Aluminum Letters:
 - 1. General:
 - a. Cast aluminum, machine cut or laser cut aluminum.
 - b. Finish: Anodized.
 - c. Mounting:
 - 1) 1 IN projected.
 - 2) Provide stainless steel mounting studs.
 - d. Text: As indicated in the SCHEDULES Article in PART 3.
 - 2. Letters:
 - a. Typeface: Match existing facility signage.
 - 3. Provide true angles, crisp corners and straight edges with no burrs or pitting in the surface.

2.4 MAINTENANCE MATERIALS

- A. 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. Room Identification Signs:
 - 1. Install signs using foam tape for interior signs and stainless steel screws (minimum of two) for exterior signs.
 - a. Stainless steel screws shall be painted to match sign color.
 - 2. Mounting Locations:
 - a. Tactile characters on signs shall be located 48 IN minimum above the finished floor or ground surface, measured from the baseline of the lowest tactile character and 60 IN maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.

- b. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leaves, the sign shall be located to the right side of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
 - c. Signs containing tactile characters shall be located so that a clear floor space of 18 IN minimum by 18 IN minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
3. Interior and exterior signs identifying permanent rooms and spaces shall comply with ADA.
- B. Aluminum Letters:
- 1. Install letters where indicated on Drawings.
 - 2. Mount to walls with 1 IN projection in accordance with manufacturer's instructions.

3.2 SCHEDULES

A. Room and Exit Identification Signs:

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
BLOWER BUILDING			
DOOR D-1	EXTERIOR	BLOWER ROOM	2
	INTERIOR	EXIT	3
DOOR D-2	EXTERIOR	ELECTRICAL ROOM	2
	INTERIOR	BLOWER ROOM	3
DOOR D-4	EXTERIOR	ELECTRICAL ROOM	2
	INTERIOR	EXIT	3
REMARKS:			
<ul style="list-style-type: none"> 1. Provide Universal Graphic Symbology. 2. Mount adjacent to pull side of door. 3. Mount adjacent to push side of door. 			

- B. Aluminum Letters:
- 1. As indicated on the Drawings.

END OF SECTION



DIVISION 23

HEATING, VENTILATING, AND AIR
CONDITIONING (HVAC)



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SECTION 23 80 00
HVAC - EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Heating, ventilating, and cooling equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Air Movement and Control Association (AMCA).
 - 2. Air Conditioning and Refrigeration Institute (ARI).
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
 - b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
 - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 4. Canadian Standards Association (CSA).
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 7. National Roofing Contractors Association (NRCA).
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 507, Standard for Electric Fans.
 - 9. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
- 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.
 - 3. It is the intent of these drawings that this be a complete mechanical job. Any errors or omissions shall be brought to the attention of the engineer prior to submittal and installation.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings.
 - 3. Product technical data including:
 - a. Acknowledgement 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. Vibration isolation.
- h. Control description.
- i. Performance data on all equipment.
- 4. Certifications:
 - a. Provide certification of thickness of corrosion-protection coating.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. As-built drawings:
 - a. Submit set of reproducible mechanical drawings showing the as-built conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Unit heater - electric:
 - a. Qmark.
 - b. Chromalox.
 - c. Brasch.
 - d. Or Equal.
 - 2. Unitary split system air conditioner:
 - a. Mitsubishi Electric.
 - b. Daikin AC.
 - c. Lennox.
 - d. Or Equal.

2.2 GENERAL

- A. All Manufactured Units:
 - 1. Comply with Specification Section 01 61 03.
 - 2. Install all manufacturer provided control components. Provide and install all field required control components and control wiring required for a complete installation.
 - 3. Factory wired and assembled.
 - 4. Use fasteners made of same material as unit.
 - 5. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
 - a. Type: As per Table 47, Chapter 48, ASHRAE HVAC Applications Handbook.
- B. Indicated manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
 - 1. Type:
 - a. Corrosion-resistant materials:
 - 1) Aluminum.
 - 2) Stainless steel.
 - 3) FRP.

2.3 MANUFACTURED UNITS

- A. Unit Heater – Electric (EUH-01 and EUH-02):
 - 1. UL listed, corrosion-resistant washable.
 - 2. 18-gauge powder coated steel cabinet.
 - 3. Copper clad steel heating elements.
 - 4. Fan shall be dynamically balanced with automatic reset overload protection.

5. Thermostat shall be wall mounted with a 40 deg F to 90 deg F temperature range. Dead band shall be 5 deg F.
 6. Provide disconnect suitable for installed location.
 7. See schedule for performance and electrical requirements.
- B. Unitary Split System Air Conditioner:
1. General:
 - a. Provide necessary control wiring and conduit as required to connect indoor unit, outdoor unit, and controller.
 - b. Provide pre-charged, insulated refrigerant line set per manufacturer's recommendations.
 2. Outdoor Unit (CU-01, CU-02, and CU-03):
 - a. General:
 - 1) The condenser unit shall be completely factory assembled, piped, wired, and tested. The condenser unit shall be designed specifically for use with the indoor unit. The unit shall be equipped with a circuit board that interfaces with the indoor unit and performs all functions necessary for operation.
 - b. Unit Cabinet:
 - 1) The casing shall be fabricated with 18-gauge galvanized steel and coated with a powder coated baked enamel.
 - c. Fan:
 - 1) The condenser unit shall be horizontal air flow and shall be furnished with either one or two direct drive propeller type fans. The fan shall be provided with raised guard to prevent contact with moving parts. The fan motor shall be mounted for quiet operation.
 - d. Coil:
 - 1) The condenser coil shall be nonferrous construction with corrugated plate fins and copper piping. The coil shall be protected with integral metal guard. The refrigerant flow from the condenser shall be controlled by means of a metering orifice.
 - e. Compressors:
 - 1) The compressors shall be high performance rotary type. Crankcase heater shall be factory mounted on the outside of the compressors. The condenser unit shall be equipped with accumulator, internal thermal overload, and high-pressure safety switch. The compressors shall be mounted to avoid vibration. The condenser unit shall be able to operate at -22 deg F ambient temperature without additional low ambient controls. the condenser unit shall be able to operate with a maximum height difference of 164 feet and have refrigerant tubing length of 164 feet between indoor and condenser unit without the need for line size changes, traps or additional oil.
 - f. Electrical:
 - 1) The condenser unit's electric power shall be as shown on the drawings. The electric motor shall meet the requirements of the mechanical schedule. The condenser unit shall be operated and controlled by the microprocessor located in the indoor unit. All control wiring interconnections between indoor and condenser units shall be with single non-polar cable with no splice.
 3. Indoor unit (FC-01, FC-02, and FC-03):
 - a. General:
 - 1) The indoor unit shall be factory assembled, wired, and run tested. The unit shall contain all factory wiring, piping, control circuit boards and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dry air instead of R410A before shipping from the factory..
 - b. Unit cabinet:

- 1) The casing shall be fabricated with 18-gauge galvanized steel. The unit casing shall be fabricated for multi directional drain and refrigerant piping and electrical connections. The unit cabinet should be able to be hung from the ceiling.
- c. Fan:
 - 1) The evaporator fan shall be inline type with direct drive three speed motor. The fan shall be statically and dynamically balanced with permanently lubricated bearings. The fan discharge shall be provided with adjustable guide vanes to change air flow direction from side to side. The fan discharge shall be provided with motorized damper to change direction of airflow from up and down.
- d. Filter:
 - 1) The indoor unit shall be equipped with return air washable filter.
- e. Indoor coil:
 - 1) The evaporator coil shall be constructed with nonferrous material with smooth plate fins and copper tubing with silver alloy brazed joints connection. The tubing shall have inner grooves for high efficiency heat exchange. The coil shall be pressure tested at the factory. Provide with factory installed electronic expansion valve. The cooling coil shall be provided with a stainless-steel condensate drain pan with minimum 1" drainpipe connection.
- f. Electrical:
 - 1) The electric motor shall meet the requirements of the mechanical schedule.
- g. Coil:
 - 1) The mini-split system heat pump unit shall have a complete factory wired control system to perform operation of the system. The control system should consist of two microprocessors, with one in the indoor wall mounted unit and second in the wall mounted remote controller interconnected with single non-polar two wire cable with no splice. The wall mounted controller shall consist of on/off switch, cool/dry fan selector, thermostat setting, timer mode, high/low fan speed, auto vane selector, test run switch and check mode switch. The thermostat shall have 2°F temperature increments with a range of 65°F to 85°F. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired wall mounted controller, providing emergency operation, and controlling the condenser unit operation. The control system shall be capable of automatic restart of the air conditioning unit when power is restored after interruption. The control system electric power voltage shall be 12 volts dc and provided by the indoor unit. The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature, and check mode for memory of most recent problems. The wall mounted controller shall control the indoor unit air sweep louvers and shall provide on/off switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with Specification Section 01 61 03.

3.2 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
 1. Inspect equipment covered by this Specification Section.
 2. Supervise pre-start adjustments and installation checks.
 3. Conduct initial start-up of equipment and perform operational checks.
 4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 75 00 on operation and maintenance of the equipment identified in this Section:
 - a. Section 23 80 00 – HVAC - Equipment, 8 hours.

3.3 ADJUSTING

- A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION

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DIVISION 26

ELECTRICAL



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SECTION 26 05 00
GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 REFERENCES

- A. Division 26 incorporates by reference the latest revisions of the following standards. They are part of Division 26 insofar as specified and modified herein. In the event of conflict between the requirements of Division 26 and those of the listed documents, the requirements of Division 26 shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
- C. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - 2. National Electrical Manufacturers Association (NEMA):
 - 3. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 4. Z535.4, Product Safety Signs and Labels.
 - 5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 6. Underwriters Laboratories, Inc. (UL).

1.2 DESIGN REQUIREMENTS

- A. All equipment anchoring and mounting shall be in accordance with manufacturer's requirements for the seismic zone criteria.

1.3 SHIPMENT AND STORAGE:

- A. Materials and equipment shall be stored in a manner to keep them dry and clean. Equipment and materials to be located indoors shall be stored indoors and sealed with plastic film wrap. Electrical and electronic equipment found stored or staged outdoors over night or in inclement weather shall be considered grounds for equipment rejection and shall be replaced at no cost to the Owner.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Electrical service components.
 - 2. Nameplates, signs, and labels.

1.5 QUALITY ASSURANCE

- A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark or label.
- C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.6 ENVIRONMENTAL CONDITIONS

- A. Unless otherwise specified, equipment and materials shall be sized and de-rated for the ambient conditions but not less than an ambient temperature of 40 degrees C at an elevation of 5800 feet without exceeding the manufacturer's stated tolerances.
- B. Plant area electrical work requirements:
 - 1. NEC area classifications per NFPA 820 are shown on the Drawings.
 - 2. The design intent is that all conduits shall be embedded in concrete walls, ceilings, floors for aboveground installations; direct earth buried or concrete encased for underground installations; or concealed (not embedded in concrete) for building interior installations unless prevented by existing construction or noted otherwise on the Drawings.
 - 3. All other electrical work shall be in accordance with the following table:

Plant Area	NEMA Enclosure Type	Exposed Conduit Type	Environment	Support Material
Electrical Room	1	RGS or IMC up to 6 feet above grade. EMT above 6 feet.	Clean/Dry	Carbon Steel
Blower Building	12	RGS or IMC up to 6 feet above grade. EMT above 6 feet.	Industrial Use	Carbon Steel
Outdoor Areas or Areas Open to Atmosphere	4X Stainless Steel	PVC coated RGS	Wet/Corrosive	Type 316 Stainless Steel or PVC-Coated Steel

- C. Areas not covered above: Use dust-tight and oil-tight NEMA 12 materials and methods.

1.7 BASIS OF DESIGN

- A. Basis of design includes the following:
 - 1. Equipment and motors as shown in the electrical one-line drawing(s) and load/panel schedules.
 - 2. Digital control systems and associated network protocols based on a specific technology platform. Such digital control systems are often proprietary in nature and include, but are not limited to, lighting control systems, generator control systems, fire alarm systems, Process Instrumentation and Control System PICS (i.e., SCADA) systems, and motor control systems.
 - 3. Unless otherwise noted, all new electrical equipment components connected to the PICS via Ethernet shall utilize native Ethernet IP protocol. The term “native” used in this context means that the protocol is integral to the equipment—a converter, gateway or card used to convert from one protocol to another (e.g., Modbus Plus to Ethernet IP) is not required. The use of these devices is not acceptable.
- B. In the event that different equipment or sizes are provided in order for the vendor’s equipment to meet mechanical performance requirements, the contractor shall coordinate various suppliers, vendors, and subcontractors to change the required electrical conduit, circuits, breakers, motor control center sections, motor controllers, and accessories, etc. as necessary to meet the vendor’s equipment installation requirements. The traits and characteristics of all provided materials, equipment, and devices shall meet the specifications. These changes to materials, equipment, and devices shall be at no cost to the Owner. Electrical submittal information shall be coordinated with the equipment and motors provided.

- C. The contract for the work will be based on materials and equipment included in the Contract Documents, and those “or-equal” and substitute products subsequently approved as outlined in Conditions of the Contract and Section 01 25 00 – Substitution Procedures. The burden of proof regarding proposed product merit and the associated cost by the Engineer/Owner to evaluate the product merit is upon the Bidder. Any assumptions regarding the possibility of post-bid approvals of or-equal or substitution requests are made at Bidder’s sole risk.
- D. “Or-Equal” or Substitute Digital Control System Materials and Equipment:
1. Technology platform standardization is required to maximize performance, efficiency, and effectiveness and to minimize technology platform total cost of ownership (TCO). Therefore, the determination of associated “or-equal” or substitute materials and equipment will be based on these elements in addition to those outlined in Conditions of the Contract and Section 01 25 00 – Substitution Procedures.
 2. TCO includes initial engineering/design costs, construction administration costs, equipment acquisition and installation costs, and ongoing operating costs and personnel/resource costs associated with management and support after construction is completed.
 - a. Design costs include digital control system design documents including, but not limited to, network diagrams, riser diagrams, I/O matrixes, schematics, wiring diagrams, equipment layouts, and bill of materials based on the specified product.
 - b. Construction administration costs include anticipated submittal reviews, RFI’s, construction changes, and record drawing development based on the specified product.
 - c. Acquisition and installation costs include software, hardware, implementation, customization, user licenses, data migration, user training, integrating third-party systems, and physical equipment installation.
 - d. Operating costs include replacement parts, additional user licenses, ongoing personnel training, software and firmware maintenance and support, additional integrations, downtime, associated third party service contracts, and electronic security.
 - e. Personnel/resource costs include personnel required to manage the system, keeping the system secure, and keeping up with technology obsolescence and maintenance.
 3. All associated written requests for approval shall include as a minimum:
 - a. Assurance that the proposed system is compatible with any existing digital control system software and hardware system elements proposed to remain in place. Depending on the Owner’s familiarity, a workshop with the Engineer and Owner may also be required to demonstrate compatibility.
 - b. TCO breakdown comparison for both the substitute product and that specified. Include actual and verifiable data from similar recent projects to validate.
 - c. Net present value (NPV) analysis for both the substitute product TCO and that specified to present to the Owner for evaluation. If elements of the existing digital control systems are proposed to remain in place, the NPV analysis shall also include ongoing operating costs and personnel/resource costs associated with managing both technology types. All Owner related ongoing operating costs and personnel/resource costs forecasted after construction shall be validated and agreed upon by the Owner.
 - d. Modified design documents showing updated network diagrams, schematics, wiring diagrams, bill of materials, and any other design related changes to accommodate the substitute equipment.
 4. Contractor represents the proposals for “or-equal” and substitute products also include:
 - a. 8 hours of training (in addition to that specified herein) for Owner operations personnel.
 - b. Spare parts (one for each type/size) including control and power boards or modules, operator interface units, and communication and input/output modules.
 - c. Engineering design and construction administration costs that may result or are required to accommodate the proposed substitute. Engineer will define these costs during evaluation of substitute.

1.8 EQUIPMENT COORDINATION AND SYSTEM RESPONSIBILITY

- A. The Contractor is responsible to review and coordinate the equipment supplied from various manufacturers and vendors. This includes but is not limited to the following:
 - 1. Obtaining specific information on equipment ratings and sizes and verifying the electrical components supplied meet the requirements such as voltage, phase, frequency, starter types, etc.
 - 2. Selecting and providing all components of approved substitute or “or-equal” materials and equipment, updating the design (as required), and provide all associated components such that they are compatible, operate reliably, and comprise a functional and listed system suitable for the required performance.
 - 3. Providing equipment that will fit within the space allocated and meet OSHA and N.E.C. clearances.
 - 4. Coordinating supplied equipment’s electrical power and control requirements.
 - 5. Providing power and control equipment, wiring, and raceways to meet the requirements of the mechanical equipment supplied.
 - 6. Providing all necessary control wiring and components for any special requirements from an equipment manufacturer.
 - 7. Providing single source coordination responsibility and ensure all system elements are products for which the manufacturer has accepted system responsibility. Agents, representatives, or entities not a direct division of the manufacturing corporation will not be accepted as a substitute for the system manufacturer.
 - 8. Confirming the equipment manufacturer does not condition or void any warranty for the performance of Division 26 products due to incompatibility of any components covered in other Divisions. This requirement does not obligate the manufacturer to warranty the workmanship or quality of components not manufactured by them.
- B. The Contractor shall verify as a minimum:
 - 1. Correct voltage, phase and frequency
 - 2. Size and space requirements
 - 3. Mounting requirements
 - 4. Correct motor starter type and size.
 - 5. Proper coordination with the controls and control system integrator.
- C. Bring any discrepancies between the electrical equipment and other equipment to the immediate attention of the Owner.
- D. The Contractor shall assure that no instrumentation or control interferences are created by the variable frequency drives (VFDs) or load wiring. The Contractor shall coordinate with the VFD manufacturer to provide necessary separation of conductors or shielding and/or filtering equipment as required by the VFD manufacturer. If interferences do occur, the Contractor shall be responsible to take corrective action at no additional cost to the Owner.

1.9 WIRING FOR VENDOR PACKAGES

- A. Equipment specifications indicate when the Vendor is responsible for providing interconnection wiring between components of a Vendor package installed on separate skids or assemblies. In this circumstance, interconnection wiring between skids or assemblies in a Vendor package shall be by Vendor.
- B. Where equipment specifications do not specify Vendor furnished wiring between skids or assemblies in a Vendor package, the Contractor shall provide and install interconnection wiring between skids or assemblies per the Vendor’s interconnection wiring requirements. Interconnection wiring between skids or assemblies in a Vendor package is not shown on the drawings.
- C. Determination of circuit requirements.
 - 1. Coordinate cable/conductor requirements with the selected Vendors to determine the correct wiring required to interconnect the package system components/skids.

2. Wiring between Vendor furnished components shipped on separate skids or assemblies shall conform to requirements specified in Division 26 and other Divisions.
 3. Wiring between the plant control system and Packages system components/skids are as shown on the drawings.
 4. Wiring between external power supplies and the packaged system components/skids are as shown on the drawings.
- D. Assign numbers and tagging for unscheduled circuit and raceway between Vendor-furnished components on separate skids or assemblies. Coordinate this information in submittals, record drawings, and O&M manuals.
- E. Update contract documents in the record drawing set to include the work provided for wiring the vendor packages.

1.10 CIRCUIT AND RACEWAY SCHEDULE

- A. Contractor shall develop circuit and raceway tagging as describe herein and as approved by the Owner. All circuits, raceways and cables shall be tagged at all terminations, switchgear, panels, MCCs, handholes, terminal junction boxes, and equipment in accordance with the approved numbers on the circuit/raceway schedule.
- B. Prefix Modifiers: The following prefix modifiers shall be used when scheduling/tagging circuits and raceways:

Prefix	Type of Function
H	Power above 600V
P	Power 120V to 600V
C	Control
A	Analog signals (i.e., 4-20ma)
D	Data
PC	Composite of power and control
F	Optical Fiber
PSP, CSP	Spare power, spare control

- C. Circuit Schedule:
1. Schedule shall include assigned circuit designation, from (equipment or terminal junction box tag number), to (equipment or terminal junction box tag number).
 2. Circuit Designation: Prefixes shall be followed by the end device equipment/instrument tag number per the following example:
 3. Circuit number = P-B-302
 4. P = Power wiring
 5. - = Delimiter
 6. B-302 = Blower B-302
- D. Raceway Schedule:
1. Schedule shall include assigned raceway designation, from (equipment, terminal junction box, or handhole tag number), to (equipment, terminal junction box, or handhole tag number).
 2. Raceway Designation: Prefixes shall be followed by a facility code and sequential raceway number per the following example:
 3. Raceway number = P-BB-001
 4. P = Raceway contains power wiring
 5. - = Delimiter
 6. BB = Facility code (e.g. Blower Building)
 7. 001 = Contractor assigned raceway number

1.11 ARC FLASH MITIGATION METHODS

- A. The following mitigation method requirements shall apply to all power distribution and utilization equipment supplied for any products supplied on the project and applies to all equipment divisions in the Contract Documents. Refer to the NFPA-70 (NEC), and NFPA-70E (Electrical Safety in the Workplace) for equipment labeling requirements.
- B. Equipment Labels: Equipment labels shall be installed on the outside of the electrical equipment enclosure, cabinet, and panels to avoid opening the equipment to access the manufacturer's data or the equipment ratings.
- C. Hinged Doors: Power distribution equipment shall have hinged rear doors where back access is shown.
- D. Insulated Power Bus and Insulated Cable Boots:
 - 1. Provide insulated power bus in power distribution equipment where accessible to installers or maintenance workers.
 - 2. Provide cable boots for power conductor connections to insulate the exposed power conductor connections.
- E. Power and Control Equipment Separation:
 - 1. Provide separation between power equipment within an enclosure, cabinet, or panel by the use of barriers, separate access doors, or by other means.
 - 2. Provide separation barriers between main breaker feeders coming into equipment and other termination points or bussing on the load side of the main breaker.
- F. Automatic Shutters: Provide automatic shutters, where possible, to close the access to the power bus when a power device is not engaged.
- G. Arc flash maintenance system for circuit breakers in other Division 26 specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
- C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range specified.

2.2 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with light gray color finish as approved by Engineer.

2.3 NAMEPLATES

- A. Nameplates shall be provided on all electrical devices, including but not limited to motor control equipment, MCC cubicles/cells/buckets, switchgear, panelboards, control stations, junction boxes, panels, harmonic filters, instruments, disconnect switches, indicating lights, meters, fire alarm panels/devices, and all electrical equipment enclosures.
- B. Nameplates shall also be provided on all electrical panel interior equipment, including but not limited to relays, circuit breakers, power supplies, terminals, contactors, and other devices.

- C. Equipment nameplates shall have both the equipment name and number.
- D. Unless noted otherwise, nameplates shall be made of 1/16" thick machine engraved laminated phenolic having black letters (not less than 1/8" high for pushbuttons/selector switches, and 3/16" high for other electrical equipment) on white background or as shown on the drawings or other sections of the specifications.
- E. Nameplates on the interior of panels and fire alarm notification/detection devices shall be White Polyester with printed thermal transfer lettering and permanent pressure sensitive acrylic; TYTON 822 or equal. All nameplates shall include the equipment name and number (and function, if applicable).
- F. Provide warning nameplates on all panels and equipment which contain multiple power sources. Lettering shall be white on red background.
- G. Nameplates shall be secured to equipment with stainless steel screws/fasteners.
- H. Nameplates for disconnect switches shall contain name and number, source tag number, as well as voltage, phases and colors of conductors.

PART 3 - EXECUTION

3.1 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.
- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.
- F. Unless otherwise detailed or dimensioned, electrical layout drawings are diagrammatic. The Contractor shall coordinate the field location of electrical material or equipment with the work of other disciplines and subcontractors. Minor changes in location of electrical material or equipment made prior to installation shall be made at no cost to the Owner.

3.2 ANCHORING AND MOUNTING

- A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for seismic zone criteria given in Section 01 81 10, Wind and Seismic Design Criteria.

3.3 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Drawings show each homerun circuit to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer.
- B. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:
 1. Analog control circuits from devices in same general area to same destination.

- a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
 - c. Analog circuits shall be continuous from source to destination. Do not add terminal junction box (TJB), splice, or combine into a multi-pair cable without authorization of Engineer.
 - d. Raceways: Do not exceed 40 percent fill.
 - e. Changes shall be documented on record drawings.
2. Discrete control circuits from devices in the same general area to the same destination.
 - a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
 - c. Raceways: Do not exceed 40 percent fill.
 - d. Changes shall be documented on record drawings.
3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
 - a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - c. Motor Branch Circuits and Associated Motor Controller Circuits Sourced from Low-Voltage Motor Control Center: Combine no more than the circuits sourced from one full voltage motor starter unit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - d. No VFD branch circuits shall be combined in the same conduit with the associated motor controller circuits.
 - e. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.4 NAMEPLATES, SIGNS, AND LABELS

- A. Arc Flash Protection Warning Signs:
 1. Field mark switchboards, motor control centers, and panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
 2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from Engineer as basis for warning signs.
 3. Engineer to provide arc flash warning signs. Contractor shall coordinate with Engineer.
- B. Equipment Nameplates:
 1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
 2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
 3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
 4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.
- C. Equipment Labels:

1. Equipment labels shall be installed on the outside of the electrical equipment enclosure, cabinet, and panels to avoid opening the equipment to access the manufacturer's data or the equipment ratings.

3.5 MOTOR CONNECTIONS

- A. Verify that the motors are purchased with the correct size motor termination boxes for the circuit content specified or submit custom fabrication drawing indicating proposed motor termination box material, size, gasket, termination kit, grounding terminal, boot type insulated motor lead connection (T&B type MSC, or equal), and motor terminal box connection/support system. Verify the motor termination box location prior to raceway rough-in.

3.6 CONDUCTOR INSTALLATION

- A. An enclosure containing disconnecting means, overcurrent devices, or electrical equipment shall not be used as a wireway or raceway for conductors not terminating within the enclosure. Provide wireways, raceways, termination boxes, or junction boxes external to the enclosure for the other conductors.

3.7 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchgear, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.8 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
- C. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.9 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

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SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 REFEREMCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - c. E814, Method of Fire Tests of Through-Penetration Fire Stops.
 2. Canadian Standards Association (CSA).
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
 4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. AB 1, Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
 - c. C12.1 Code for Electricity Metering
 - d. C12.6 Phase-Shifting Devices Used in Metering, Marking and Arrangement of, Terminals for
 - e. CP 1, Shunt Capacitors.
 - f. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - g. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - h. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. Underwriters Laboratories Inc. (UL):
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.
 - g. 943, Standard for Ground-Fault Circuit-Interrupters.
 - h. 1059, Standard for Terminal Blocks.
 - i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.2 SUBMITTALS

- A. Action Submittals:
1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.

- f. Timers.
- g. Fuses.
- h. Uninterruptible Power Supply
- i. Terminal blocks.
- j. Magnetic control relays.
- k. Intrinsic safety barriers
- l. Time delay relays.
- m. Magnetic contactors.
- n. Support and framing channel.
- o. Firestopping.
- p. Enclosures: Include enclosure data for products having enclosures.

1.3 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:
 - 1. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

- A. General:
 - 1. Type: Molded case.
 - 2. Trip Ratings: 15-800 amps.
 - 3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
 - 4. Suitable for mounting and operating in any position.
 - 5. NEMA AB 1 and UL 489.
- B. Operating Mechanism:
 - 1. Overcenter, trip-free, toggle type handle.
 - 2. Quick-make, quick-break action.
 - 3. Locking provisions for padlocking breaker in open position.
 - 4. ON/OFF and TRIPPED indicating positions of operating handle.
 - 5. Operating handle to assume a center position when tripped.
- C. Trip Mechanism:
 - 1. Individual permanent thermal and magnetic trip elements in each pole.
 - 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 - 3. Two and three pole, common trip.
 - 4. Automatically opens all poles when overcurrent occurs on one pole.
 - 5. Test button on cover.
 - 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
 - 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings:
 - 1. Equal to, or greater than, available fault current or interrupting rating shown.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5 mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
 - 1. Ground fault sensor shall be rated same as circuit breaker.
 - 2. Push-to-test button.
- F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30 mA ground fault (UL-listed for equipment ground fault protection).

- G. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.
- H. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
- I. Connections:
 - 1. Supply (line side) at either end.
 - 2. Mechanical wire lugs, except crimp compression lugs where shown.
 - 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 - 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
- J. Enclosures for Independent Mounting:
 - 1. See Article Enclosures.
 - 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 - 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.2 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1.
- C. Short Circuit Rating: 200,000 amps RMS symmetrical with Class R, Class J, or Class L fuses installed.
- D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- E. Connections:
 - 1. Mechanical lugs, except crimp compression lugs where shown.
 - 2. Lugs removable/replaceable.
 - 3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
- F. Fuse Provisions:
 - 1. 30 amp to 600 amp rated shall incorporate rejection feature to reject all fuses except Class R.
 - 2. 601 amp rated and greater shall accept Class L fuses, unless otherwise shown.
- G. Enclosures: See Article Enclosures.
- H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.3 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1.
- C. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type, single throw or double throw as required by Drawings, with external markings clearly indicating ON/OFF positions.
- D. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.
- E. Auxiliary Contact:
 - 1. As required to disconnect adjustable frequency drive control power or other auxiliary controls.
 - 2. Operation: Make before power contacts make and break before power contacts break.

3. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
- F. Enclosures: See Article Enclosures.
- G. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.4 FUSE, 250-VOLT AND 600-VOLT

- A. Power Distribution, General:
1. Current-limiting, with 200,000 ampere rms interrupting rating.
 2. Provide to fit mountings specified with switches.
 3. UL 248.
- B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:
1. Class: RK 1.
 2. Type: Dual element, with time delay.
 3. Manufacturers and Products:
 - a. Bussmann; Types LPS RK (600 volts) and LPN RK (250 volts).
 - b. Littelfuse; Types LLS RK (600 volts) and LLN-RK (250 volts).
- C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:
1. Class: L.
 2. Double O rings and silver links.
 3. Manufacturers and Products:
 - a. Bussmann; Type KRP C.
 - b. Littelfuse, Inc.; Type KLPC.
- D. Cable Limiters:
1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
 2. Manufacturer and Product: Bussmann; K Series.
- E. Ferrule:
1. 600V or less, rated for applied voltage, small dimension.
 2. Ampere Ratings: 1/10 amp to 30 amps.
 3. Dual-element time-delay, time-delay, or nontime-delay as required.
 4. Provide with blocks or holders as indicated and suitable for location and use.
 5. Manufacturers:
 - a. Bussmann.
 - b. Littlefuse, Inc.

2.5 CONTROL DEVICES

- A. HOA Padlocking Cover: Provide padlocking cover on all HOA switches. Cover shall be clear plastic. AB 800T or approved equal.
- B. Potentiometer Units: Provide ohm value for the application. Provide with back plate marked with 0-100% in 10% increments.
1. Legend Plate Label: SPEED.
- C. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600. Provide bifurcated contacts for 24Vdc switching.
- D. Selector Switch Operating Lever: Standard.
- E. Emergency stop/close buttons shall be 2-position, push-pull/twist release type with red jumbo mushroom head.
- F. Indicating Light: press-to-test LED, full voltage.
- G. Pushbutton Color:
1. ON or START: Black.
 2. OFF or STOP: Red.

- H. Pushbutton and selector switch lockable in OFF position where indicated.
- I. Legend Plate:
 - 1. Material: Aluminum.
 - 2. Engraving: Enamel filled in high contrasting color.
 - 3. Text Arrangement: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, indicating specific function.
 - 4. Letter Height: 7/64 inch.
- J. Manufacturers and Products:
 - 1. Allen Bradley 800H or 800T, or equivalent.

2.6 INDICATING LAMP COLORS

- A. All indicating lamps shall have an integrated lamp-test function or a common lamp test switch for all lamps on a single line-up of equipment.
- B. Unless otherwise specified, indicating lights shall be equipped with colored lenses in accordance with the following schedule:

Color	Function	Example
Green	Run, open valve	Equipment operating, motor running
Red	Stopped, closed valve	Alarm, end of cycle, motor stopped
White or Clear	Normal condition, Ready	Control power on, status OK
Amber (yellow)	Abnormal condition	Failure of equipment or status abnormal, fault condition

2.7 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.
 - 3. Electrovert USA Corp.

2.8 MAGNETIC CONTROL RELAY

- A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.
- B. NEMA ICS 2, Designation: A600 (600 volts).
- C. Time Delay Relay Attachment:
 - 1. Pneumatic type, timer adjustable from 0.2 second to 60 seconds (minimum).
 - 2. Field convertible from ON delay to OFF delay and vice versa.
- D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.
- E. Manufacturers and Products:
 - 1. Eaton/Cutler-Hammer; Type M 600.
 - 2. General Electric Co.; Type CR120B.

2.9 TIME DELAY RELAY

- A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.
- B. NEMA ICS 2 Designation: B150 (150 volts).
- C. Solid-state electronic, field convertible ON/OFF delay.
- D. One normally open and one normally closed contact (minimum).
- E. Repeat accuracy plus or minus 2 percent.
- F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.
- G. Manufacturers and Products:
 - 1. Square D Co.; Type F.
 - 2. Eaton/Cutler-Hammer.
 - 3. General Electric Co.

2.10 INTRINSIC SAFETY BARRIER

- A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.
- B. Rating: Power source shall be rated 24 volts dc, nominal, with not more than 250 volts available under fault conditions.
- C. Contact Rating: 5 amps, 250 volts ac.
- D. Mounting: Rail or surface.
- E. Manufacturers and Products:
 - 1. MTL, Inc.
 - 2. R. Stahl, Inc.

2.11 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12 gauge minimum, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.
- C. PVC Coated Framing Channel: Carbon steel framing channel with 40 mil polyvinyl chloride coating.
- D. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge minimum.

- E. Manufacturers:
 1. B Line Systems, Inc.
 2. Unistrut Corp.
 3. Aickinstrut.

2.12 FIRESTOPS

- A. General:
 1. Provide UL 1479 classified hourly fire-rating equal to, or greater than, the assembly penetrated.
 2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
 3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by Underwriters Laboratories Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
- B. Firestop System:
 1. Formulated for use in through-penetration firestopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.
 2. Fill, Void, or Cavity Material: 3M Brand Fire Barrier Caulk CP25, Putty 303, Wrap/Strip FS195, Composite Sheet CS195 and Penetration Sealing Systems 7902 and 7904 Series.
 3. Two-Part, Foamed-In-Place, Silicone Sealant: Dow Corning Corp. Fire Stop Foam, General Electric Co. Pensil 851.

2.13 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer’s standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.
- D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the following table:

ENCLOSURES			
Location	Finish	Environment	NEMA 250 Type
Indoor	Finished	Dry	1
Indoor	Unfinished	Industrial Use	12
Outdoor	Any	Denoted “WP”	3R
Indoor and Outdoor	Any	Wet and/or Corrosive	4X: 304 Stainless Steel
Indoor and Outdoor	Any	Wet, Dust, or Oil	13
Indoor	Any	Hazardous Gas	7
Outdoor	Any	Hazardous Gas	8

PART 3 - EXECUTION

3.1 GENERAL

- A. Install equipment in accordance with manufacturer’s recommendations.

3.2 CONTROL DEVICES

- A. Unless otherwise shown, install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.
- B. Unless otherwise shown, install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas.

3.3 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 - 1. Interior, Dry (Noncorrosive) Locations:
 - a. Steel Raceway: Carbon steel or paint coated.
 - 2. Interior, Corrosive (Wet or Dry) Locations:
 - a. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel or PVC-coated steel.
 - 3. Outdoor Locations:
 - a. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel or PVC coated steel.
- C. Paint cut ends prior to installation with the following:
 - 1. Carbon Steel Channel: Zinc-rich primer.
 - 2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 3. Nonmetallic Channel: Epoxy resin sealer.
 - 4. PVC-Coated Channel: PVC patch.

3.4 INTRINSIC SAFETY BARRIERS

- A. Install in compliance with ISA RP12.06.01.
- B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.
- C. Stencil “INTRINSICALLY SAFE CIRCUIT” on all boxes enclosing barriers.

3.5 FIRESTOPS

- A. Install in strict conformance with manufacturer’s instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 26 05 19
CONDUCTORS AND COMMUNICATIONS CABLING

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
 2. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - b. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
 4. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
 - d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
 6. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
 7. American National Standards Institute (ANSI)
 - a. ANSI X3.166, Information Systems--Fiber Data Distributed Interface (FDDI)--Token Ring Physical Layer Medium Dependent (PMD)
 8. Underwriters Laboratories Inc. (UL):
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - i. 1569, Standard for Safety for Metal-Clad Cables.

- j. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.
- k. 1072, Standard for Safety for Medium-Voltage Power Cables.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
 - c. Fiber optic data cable
 - 2. Cable Pulling Calculations:
 - a. Ensure submitted and reviewed before cable installation.
 - b. Provide for the following cable installations:
 - 1) Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.
 - 2) Power and control conductor, and control and instrumentation cable installations in duct banks.
 - 3) Feeder circuits; single conductors #4/0 and larger.
 - 3. Fiber Optic Cable light budget calculations:
 - a. Describe design parameters used in calculation including light attenuation (dB per km), cable construction details, and connector characteristics and losses.
 - b. Use spreadsheet format that calculates total power loss, received power, receiver overload margin, and receiver power margin.
 - 4. Testing Related Submittals:
 - a. Optical Time Domain Reflectometer (OTDR) certification, current within last 6 months.
 - b. Pre-installation and post installation test documentation as specified herein.
- B. Informational Submittals:
 - 1. Factory Test Report for conductors 600 volts and below.
 - 2. Journeyman lineman or electrician splicing credentials.

1.3 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.
- B. Terminations and splices for conductors above 600 volts: Work shall be performed by journeyman lineman with splicing credentials or electrician certified to use materials approved for cable splices and terminations.

PART 2 - PRODUCTS

2.1 CONDUCTORS 600 VOLTS AND BELOW

- A. Conform to applicable requirements of NEMA WC 70.
- B. Conductor Type: Stranded copper.
- C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.
- D. Flexible Cords and Cables:
 - 1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
 - 2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.2 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer’s name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Multiconductor Control Cable:

1. Conductors:
 - a. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

C. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

- D. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.
1. Outer Jacket: 45-mil nominal.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.32-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and blue.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- E. 18 AWG, Multitwisted Shielded Pairs, with a Common Overall Shield, Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.
1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Jacket: 4-mil nylon.
 - f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
 - g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
 2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
 3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

- F. Multiconductor Adjustable Frequency Drive Power Cable:
1. Conductors:

- a. Class B, stranded coated copper.
- b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
2. Conductors #2AWG and smaller: Utilize 300% ground foil/braid design.
 - a. Grounding Conductor: Insulated stranded copper.
 - b. Sheath:
 - 1) UL 1277 Type TC, 90 degrees C.
 - 2) Continuous shield, A1/polyester foil, tinned copper drain wires, overall tinned copper braid.
3. Conductors larger than #2AWG: Utilize 100% ground symmetrical design.
 - a. Grounding Conductors: Three symmetrical bare copper 100% ground.
 - b. Outer Shield:
 - 1) 100% coverage
 - 2) Two spiral copper tape shields.
4. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.
5. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Minimum Jacket Thickness (Mils)
12 AWG	12	4	0.655	50
10 AWG	10	4	0.769	50
8 AWG	8	4	0.940	50
6 AWG	6	4	1.038	50
4 AWG	4	4	1.180	50
2 AWG	2	4	1.351	50
#2/0 AWG	3#4 (#2/0 Sym. Seg. Gnd.)	3	1.4	83
#3/0 AWG	3#4 (#3/0 Sym. Seg. Gnd.)	3	1.5	83
#4/0 AWG	3#2 (#4/0 Sym. Seg. Gnd.)	3	1.62	83

6. Manufacturers and Products:
 - a. Belden; Series 29500.
 - b. Alpha Wire; Series V.
 - c. LAPP USA; OLFLEX VFD Slim.

2.3 300-VOLT RATED CABLE

A. General:

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.
6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

- B. Twisted Pair Fire Alarm Cable, Shielded: Power limited fire protective signaling circuit cable meeting requirements of NFPA 70, Article 760.
 - 1. Cable: Pass NFPA 262, 70,000 Btu flame test and listed by State Fire Marshall.
 - 2. Outer Jacket: Red in color, identified along its entire length as fire protective signaling circuit cable.
 - 3. Conductors:
 - a. Solid, tinned, or bare copper shielded, with stranded tinned copper drain wire.
 - b. Insulation: 15-mil PVC.
 - 4. Cable Sizes:

Wire Size	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Inches)
12	0.36	0.042
14	0.32	0.042
16	0.26	0.037
18	0.23	0.037

- 5. Manufacturers:
 - a. West Penn Wire.
 - b. Coleman Cable, Inc.

2.4 SPECIAL CABLES

- A. Foil Shielded/Unshielded Twisted Pair (F/UTP) Telephone and Data Cable, 300V:
 - 1. Category 6A, UL listed, and third party verified to comply with TIA/EIA 568-C.2 Category 6A requirements.
 - 2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
 - 3. Four each individually twisted pair, 23 AWG conductors, with polyolefin insulation and blue PVC jacket.
 - 4. Outer foil screen with 26 AWG tinned copper shield drain wire.
 - 5. NEC/UL Riser (CMR) rated.
 - 6. Cable shall withstand a bend radius of 1.2-inch minimum at a temperature of minus 10 degrees C maximum without jacket or insulation cracking.
 - 7. Manufacturer and Product: Belden; 10GX62F.
- B. Multimode Fiber-Optic Cable:
 - 1. 24-count fiber cable.
 - 2. Outdoor/indoor; Riser Rated (OFNR).
 - 3. Tight buffered.
 - 4. Fibers and buffer tubes shall be color coded with distinct and recognizable colors in accordance with EIA/TIA-598.
 - 5. Jacket: Flame retardant, UV resistant, black.
 - 6. Type:
 - a. Approvals and Listings: NEC OFNR, CSA FT-4, ICEA S104-696.
 - b. Fiber Type: Multimode
 - c. Nominal Cable Outer Diameter: 0.31 in.
 - d. Core Diameter: 50 μm
 - e. Fiber Category: OM3
 - f. Wavelengths: 850 nm/1300 nm
 - g. Maximum Attenuation: 2.8 dB/km/1.0 dB/km
 - h. Operating Temperature Range: -40 to +70 Deg C
 - i. Max Tensile Loading: 300/90 lbf (Installation/Operation)

- j. Minimum Cable Bending Radius: 4.7/3.1 inches (Installation/Operation).
- 7. Manufacturers:
 - a. Corning Cable Systems, Corning FREEDM One (024T8F-31180-29) or equivalent.

2.5 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.6 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW AND FIBER OPTICS

- A. Tape:
 - 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 - 3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.
- B. Identification Devices:
 - 1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.
 - 2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
 - 3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
 - 4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2 inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
 - 5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.
- C. Connectors and Terminations:
 - 1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
 - 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
 - 3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:

- 1) Thomas & Betts.
- 2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.
- D. Cable Lugs:
 1. In accordance with NEMA CC 1.
 2. Rated 600 volts of same material as conductor metal.
 3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
 4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.
- E. Cable Ties:
 1. Nylon, adjustable, self-locking, and reusable.
 2. Manufacturer and Product: Thomas & Betts; TY-RAP.
- F. Heat Shrinkable Insulation:
 1. Thermally stabilized cross-linked polyolefin.
 2. Single wall for insulation and strain relief.
 3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
 4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.
- G. F/UTP cable:
 1. Provide terminators, connectors, and junctions necessary for a complete Ethernet/IP system.
 2. Connector type: RJ-45.
- H. Fiber optics:
 1. Provide markers for labeling each end of a fiber optic cable.
 2. Provide markers for individual fiber optic strands, jumpers, and patch cables. Attach to fiber using tie wrap or other approved method of securing the marker.
 3. Markers must have space for typed or machine printed text.
 4. Connector type: LC.
 5. Innerduct:
 - a. Smooth walled polyethylene tube to protect fiber optic cable.
 - b. Install innerduct in conduit.
 - c. Install fiber optic cable in innerduct.
 - d. Manufacturers: Carlon, or equal.
 6. Split Duct:
 - a. At patch panels and pull boxes provide smooth walled polyethylene split innerduct to bridge gap between panel and end of conduit.

2.7 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.
- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- E. Manufacturers:
 - 1. Ideal Co.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.8 WARNING TAPE

- A. As specified in Section 26 05 33, Raceway and Boxes.

2.9 SOURCE QUALITY CONTROL

- A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.
- B. Conductors above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 8 partial discharge level test for EPR insulated cable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.
- J. VFD Wiring: Shielded power cables shall be used for load-side circuits between VFD's and motors.

3.2 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
 - 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
 - 2. 8 AWG and Smaller: Provide colored conductors.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow

Note: Phase A, B, C implies direction of positive phase rotation.

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.3 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, control conductor circuits, and fiber optic cables at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuit Schedules: Identify using circuit schedule designations as specified in Section 26 05 00, General Requirements for Electrical Work.
- C. Method:
 - 1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
 - 2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
 - 3. Taped-on markers or tags relying on adhesives not permitted.

3.4 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.
- C. Connections and Terminations:
 - 1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
 - 3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
 - 4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.

5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
 6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
 7. Place no more than one conductor in any single-barrel pressure connection.
 8. Install crimp connectors with tools approved by connector manufacturer.
 9. Install terminals and connectors acceptable for type of material used.
 10. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
1. Insulate uninsulated connections.
 2. Indoors: Use general-purpose, flame-retardant tape or single wall heat shrink.
 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
1. Remove surplus wire, bridle and secure.
 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
 4. Where connections of cables installed under this section are to be made under Section 40 90 00, Instrumentation for Process Control Basic Requirements leave pigtailed of adequate length for bundled connections.
 5. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.
- I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.5 FIBER OPTIC CABLE:

- A. Innerduct:
1. Install in accordance with manufacturer's recommendation.
 2. Use single unjoined lengths from one handhole or pull point to the next.
 3. End innerduct at manholes or pull points.
 4. One fiber optic cable per innerduct, maximum.
- B. Fiber Optic Cable:
1. Install cables in innerduct.
 2. Provide lengths required to perform installations as indicated on Drawings.

3. Install cable directly from shipping reels. Ensure cable is not:
 - a. Dented, nicked, or kinked.
 - b. Subjected to pull stress greater than or bend radius less than manufacturers specification.
 - c. Otherwise subjected to treatment which may damage fiber strands during installation.
 4. Splices: None. Install cables in unspliced lengths between fiber patch panels.
 5. Terminate at fiber patch panel:
 - a. Fan out fiber cable to allow direct connectorization of fiber optic cable.
 - b. Sleeve over individual fiber with Kevlar reinforced furcation tubes.
 - c. At point of convergence of furcation tubes, provide strain relief with high density plastic fan-out collar.
 - d. Terminate all fibers.
- C. Provide No. 12 stranded copper tracer wire for each underground conduit containing fiber optic cable.
- D. Contractor shall use zip-cord jumper cables between patch/breakout panels and communications equipment.
- E. Test with optical time domain reflectometer (OTDR) prior to installation and after installation. Test Polarization Mode Dispersion (PMD) and Fiber Distributed Data Interface (FDDI) requirements for the following:
 1. Transmit power levels
 2. AC extinction ratio
 3. Optical wave shape
 4. Duty cycle distortion
 5. Data dependent jitter
 6. Random jitter
 7. Transmit frequency
 8. Minimum optical input
 9. Receiver jitter tolerance
- F. Pre-installation tests:
 1. Perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications, and is free of defects, breaks and damages by transportation and manufacturing processes. Perform tests on all reels of cable. Cable shall not be installed until the Engineer has reviewed the test report.
 2. Verify continuity and attenuation or loss for each fiber on each reel and document results of physical inspections to identify any cable and reel damage conditions, and any deviations from the manufacturer's specifications.
 3. Document test results and submit the report to the Engineer for review.
- G. Post-Installation Tests:
 1. Conduct the following tests on each fiber in the cable segment. Tests shall be conducted at both 850 and 1300 nm. No splice loss shall have a loss of 0.15 dB or greater with fiber attenuation measured in dB/km.
 2. Measure the attenuation of each optical fiber in both directions using a with an Optical Loss Test Set (OLTS) at both 850 nm and 1300 nm. Test shall be conducted per TIA/EIA 526-7. Provide a reference power level measured with a patch cord and connectors of the same types used on the fiber cable. Measure and record the reference power level of the Laser Light Source. Measure and record the received power level of each optical. Repeat the same measurements in the other direction.
 3. Pigtail splices shall have a loss no greater than 0.15 dB, as determined by either a Profile Alignment System (PAS) or Light Injection (LID) splice loss estimate, at the time the splice is made. Splices with an optical loss of greater than 0.15 dB shall be redone. OTDR traces at both 1310 nm and 1550 nm wavelengths display no unexplained losses, reflectance events, or other discontinuities.

4. Test Documentation:
 - a. Hard copy of OTDR plots.
 - b. Results of bi-directional test with power meter and light source.
 - c. Provide an updated version of the light budget spreadsheet including actual cable lengths used, and actual losses measured by tests.

H. The Owner shall be notified a minimum of 5 days prior to tests and reserve the right to witness field tests.

3.6 CONDUCTOR ARC AND FIREPROOFING

- A. Install arc and fireproofing tape on 600-volt single conductors and cables, except those rated Type TC, throughout entire exposed length in manholes, handholes, and vaults.
- B. Wrap conductors of same circuit entering from separate conduit together as single cable.
- C. Follow tape manufacturer's installation instructions.
- D. Secure tape at intervals of 5 feet with bands of tape binder. Each band to consist of a minimum of two wraps directly over each other.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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): C2, National Electrical Safety Code (NESC).
 2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.2 SUBMITTALS

- A. Action Submittals: Product data for all specified products.

1.3 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 - PRODUCTS

2.1 GROUND ROD

- A. Material: Copper-clad.
- B. Diameter: Minimum 5/8 inch.
- C. Length: 10 feet.

2.2 GROUND CONDUCTORS

- A. As specified in Section 26 05 19, Conductors and Communications Cabling.

2.3 CONNECTORS

- A. Exothermic Weld Type:
1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 2. Indoor Weld: Utilize low-smoke, low-emission process.
 3. Manufacturers:
 - a. Erico Products, Inc. Cadweld and Cadweld Exolon.
 - b. Thermoweld.
- B. Compression Type:
1. Compress-deforming type; wrought copper extrusion material.
 2. Single indentation for conductors 6 AWG and smaller.
 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
 5. Manufacturers:
 - a. Burndy Corp.; Hyground Irreversible Compression.
 - b. Thomas and Betts Co.
 - c. ILSCO.

- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 - 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.

2.4 ADJUSTABLE FREQUENCY DRIVE POWER CABLE SHIELD GROUND:

- A. Cold-shrinkable seal with copper braid and full diameter constant force spring.
- B. Size range as required for jacket diameter.
- C. Manufacturer: Southwire, Spec 85451.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with NFPA 70 and IEEE C2.
- B. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- G. Multiconductor Adjustable Frequency Drive Power Cables:
 - 1. Comply with VFD manufacturer grounding requirements.
 - 2. Provide shield termination and grounding.
 - 3. Ground shield at VFD ground bus and at motor.
- H. Shielded Instrumentation Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.

3.2 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.3 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box; if none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 hp and Above: Use furnished ground lug in motor connection box; if none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.4 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.
- C. Space multiple ground rods by one rod length.
- D. Install to 8 feet below local frost depth.

3.5 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer prior to backfilling ground connections.
- B. Exothermic Weld Type:
 - 1. Wire brush or file contact point to bare metal surface.
 - 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
 - 3. Avoid using badly worn molds.
 - 4. Mold to be completely filled with metal when making welds.
 - 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.
- C. Compression Type:
 - 1. Install in accordance with connector manufacturer's recommendations.
 - 2. Install connectors of proper size for grounding conductors and ground rods specified.
 - 3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.
- D. Mechanical Type:
 - 1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
 - 2. Install in accordance with connector manufacturer's recommendations.
 - 3. Do not conceal mechanical connections.

3.6 METAL STRUCTURE GROUNDING

- A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.7 HANDHOLE GROUNDING

- A. Install one ground rod inside each manhole and handhole larger than 24-inch by 24-inch inside dimensions.
- B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.
- C. Make connections of grounding conductors fully visible and accessible.
- D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.8 TRANSFORMER GROUNDING

- A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

3.9 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
 2. ASTM International (ASTM):
 - a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
 4. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. C80.1, Electrical Rigid Steel Conduit (ERSC).
 - c. C80.3, Steel Electrical Metallic Tubing (EMT).
 - d. C80.6, Electrical Intermediate Metal Conduit (EIMC).
 - e. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - f. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
 - g. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. Underwriters Laboratories Inc. (UL):
 - a. 1, Standard for Safety for Flexible Metal Conduit.
 - b. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
 - c. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
 - d. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
 - e. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
 - f. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - g. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
 - h. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
 - i. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
 - j. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - k. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.2 SUBMITTALS

- A. Action Submittals: Manufacturer's Literature:
1. Rigid galvanized steel conduit.
 2. Intermediate metal conduit
 3. PVC Schedule 40 conduit.

4. PVC-coated rigid galvanized steel conduit, submittal to include copy of manufacturer's warranty.
 5. Flexible metal, liquid-tight conduit.
 6. Conduit fittings.
 7. Wireways.
 8. Device boxes for use in hazardous areas.
 9. Junction and pull boxes used at or below grade.
 10. Large junction and pull boxes.
 11. Terminal junction boxes.
 12. Precast Handholes:
 - a. Dimensional drawings and descriptive literature.
 - b. Traffic loading calculations.
 - c. Accessory information.
 13. Equipment and machinery proposed for bending metal conduit.
 14. Method for bending PVC conduit less than 30 degrees.
- B. Informational Submittals:
1. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.3 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
- B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received training on installation procedures.

PART 2 - PRODUCTS

2.1 CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit (RGS):
1. Meet requirements of NEMA C80.1 and UL 6.
 2. Material: Hot-dip galvanized with chromated protective layer.
- B. Intermediate Metal Conduit (IMC):
1. Meet requirements of NEMA C80.6 and UL 1242.
 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- C. Electric Metallic Tubing (EMT):
1. Meet requirements of NEMA C80.3 and UL 797.
 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- D. PVC Schedule 40 Conduit:
1. Meet requirements of NEMA TC 2 and UL 651.
 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- E. PVC-Coated Rigid Galvanized Steel Conduit:
1. Meet requirements of NEMA RN 1 and ETL.
 2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.

- b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2-mil nominal thickness.
 - 3. Threads: Hot-dipped galvanized and factory coated with urethane.
 - 4. Bendable without damage to interior or exterior coating.
- F. Flexible Metal, Liquid-Tight Conduit:
 - 1. UL 360 listed for 105 degrees C insulated conductors.
 - 2. Material: Galvanized steel with extruded PVC jacket.
- G. Flexible, Nonmetallic, Liquid-Tight Conduit:
 - 1. Material: PVC core with fused flexible PVC jacket.
 - 2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
 - 3. Manufacturers and Products:
 - a. Carlon; Carflex or X-Flex.
 - b. T & B; Xtraflex LTC or EFC.

2.2 FITTINGS

- A. Rigid Galvanized Steel and Intermediate Metal Conduit:
 - 1. General:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
 - 2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-I.
 - 2) O-Z/Gedney; Type HB.
 - 3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers and Products:
 - 1) Appleton; Series GIB.
 - 2) O-Z/Gedney; Type HBLG.
 - 4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat with bonding screw.
 - b. UL listed for use in wet locations.
 - c. Manufacturers and Products:
 - 1) Appleton, Series HUB-B.
 - 2) O-Z/Gedney; Series CH.
 - 3) Meyers; ST Series.
 - 5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Conditions):
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
 - c. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
 - 6. Couplings: As supplied by conduit manufacturer.
 - 7. Unions:

- a. Concrete tight, hot-dip galvanized malleable iron.
- b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
 - 2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
- 8. Conduit Sealing Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYF, EYM, or ESU.
 - 2) Crouse-Hinds; Type EYS or EZS.
 - 3) Killark; Type EY or Type EYS.
- 9. Drain Seal:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYD.
 - 2) Crouse-Hinds; Type EYD or Type EZD.
- 10. Drain/Breather Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; ECD.
- 11. Expansion Fitting:
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement:
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.
 - 2) Expansion Movement Only:
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
- 12. Cable Sealing Fitting:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products:
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.
- B. PVC Conduit:
 - 1. Meet requirements of NEMA TC 3.
 - 2. Type: PVC, slip-on.
- C. PVC-Coated Rigid Galvanized Steel Conduit:
 - 1. Meet requirements of UL 514B.
 - 2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
 - 3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
 - 4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
 - 5. Overlapping pressure-sealing sleeves.
 - 6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
 - 7. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
 - c. Plasti-Bond.
 - 8. Expansion Fitting:
 - a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.
- D. Flexible Metal, Liquid-Tight Conduit:
 - 1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - 2. Insulated throat and sealing O-rings.

3. Manufacturers and Products:
 - a. Thomas & Betts; Series 5331.
 - b. O-Z/Gedney; Series 4Q.
- E. Flexible, Nonmetallic, Liquid-Tight Conduit:
 1. Meet requirements of UL 514B.
 2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
 3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
 4. Manufacturers and Products:
 - a. Carlon; Type LT.
 - b. O-Z/Gedney; Type 4Q-P.
 - c. Thomas & Betts; Series 6300.
- F. Flexible Coupling, Hazardous Locations:
 1. Approved for use in atmosphere involved.
 2. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.
 3. Outer bronze braid and an insulating liner.
 4. Conductivity equal to a similar length of rigid metal conduit.
 5. Manufacturers and Products:
 - a. Crouse-Hinds; Type ECGJH or Type ECLK.
 - b. Appleton; EXGJH or EXLK.
- G. Watertight Entrance Seal Device:
 1. New Construction:
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
 2. Cored-Hole Application:
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.3 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.
- B. Cast Metal:
 1. Box: Malleable iron.
 2. Cover: Gasketed, weatherproof, malleable iron, or cast ferrous metal, with stainless steel screws.
 3. Hubs: Threaded.
 4. Lugs: Cast Mounting.
 5. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS or Type FD.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 6. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA or Type EAJ.
 - b. Appleton; Type GR.
- C. PVC-Coated Cast Metal:
 1. Type: One-piece.
 2. Material: Malleable iron, cast ferrous metal.
 3. Coating:
 - a. Exterior Surfaces: 40-mil PVC.
 - b. Interior Surfaces: 2-mil urethane.
 4. Manufacturers:

- a. Robroy Industries.
 - b. Ocal.
- D. Nonmetallic:
- 1. Box: PVC.
 - 2. Cover: PVC, weatherproof, with stainless steel screws.
 - 3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers.

2.4 JUNCTION AND PULL BOXES

- A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.
- C. Large Sheet Steel Box:
- 1. NEMA 250, Type 1.
 - 2. Box: Code-gauge, galvanized steel.
 - 3. Cover: Hinged with clamps.
 - 4. Machine Screws: Corrosion-resistant.
- D. Large Cast Metal Box:
- 1. NEMA 250, Type 4.
 - 2. Box: Cast malleable iron or electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
 - 3. Cover: Hinged with clamps.
 - 4. Gasket: Neoprene.
 - 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 6. Manufacturer and Product, Surface Mounted, Hinged Type: O-Z/Gedney; Series YW.
 - 7. Manufacturers and Products, Recessed Type:
 - a. Crouse-Hinds; Type WJBF.
 - b. O-Z/Gedney; Series YR.
- E. Large Cast Metal Box, Hazardous Locations:
- 1. NEMA 250 Type 7 or Type 9 as required for Class, Division, and Group involved.
 - 2. Box: Cast ferrous metal, electro-galvanize finished with drilled and tapped conduit entrances.
 - 3. Cover: Hinged with screws.
 - 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 5. Manufacturers and Products:
 - a. Crouse-Hinds; Type EJB.
 - b. O-Z/Gedney; Series AJBEW.
- F. Large Stainless Steel Box:
- 1. NEMA 250 Type: 4X
 - 2. Box: 14-gauge, ASTM A240/A240M, Type: 316 stainless steel, with white enamel painted interior mounting panel.
 - 3. Cover: Hinged with clamps.
 - 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 5. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Wiegman.
- G. Large Steel Box:
- 1. NEMA 250 Type 3R
 - 2. Box: 14-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by Engineer.
 - 3. Cover: Hinged with clamps.

4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 5. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Wiegman.
- H. Concrete Box, Nontraffic Areas:
1. Box: Reinforced, cast concrete with extension.
 2. Cover: Steel diamond plate with locking bolts.
 3. Cover Marking: ELECTRICAL, CONTROL, SIGNAL, TELEPHONE, or as shown.
 4. Size: 10 inches by 17 inches, minimum.
 5. Manufacturers and Products:
 - a. Utility Vault Co.; Series 36-1017.
 - b. Christy, Concrete Products, Inc.; N9.
 - c. Quazite; "PG" Style.
- I. Concrete Box, Traffic Areas:
1. Box: Reinforced, cast concrete with extension and bottom slab.
 2. Cover: Steel checked plate; H/20 loading.
 3. Cover Marking: ELECTRICAL, CONTROL, SIGNAL, TELEPHONE, or as shown.
 4. Manufacturers and Products:
 - a. Oldcastle Precast; Model 3030-LA (3030-SB with No. 3030-P Cover).
 - b. Christy, Concrete Products, Inc.; B1017.

2.5 TERMINAL JUNCTION BOX

- A. Cover: Hinged, unless otherwise shown.
- B. Interior Finish: Paint with white enamel or lacquer.
- C. Terminal Blocks:
 1. Separate connection point for each conductor entering or leaving box.
 2. Spare Terminal Points: 25 percent, minimum.

2.6 METAL WIREWAYS

- A. Meet requirements of UL 870.
- B. Type: Steel-enclosed, lay-in type.
- C. Cover: Removable, screw type.
- D. Rating: Outdoor raintight.
- E. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.
- F. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.
- G. Knockouts: Without knockouts, unless otherwise indicated.
- H. Manufacturers:
 1. Circle AW.
 2. Hoffman.
 3. Square D.

2.7 NONMETALLIC WIREWAY

- A. Rating: Outdoor, corrosion resistant, raintight, NEMA Type 12 and Type 3R.
- B. Type: Fiberglass-enclosed, with removable cover.
- C. Captivated, corrosion-resistant cover screws.
- D. Oil-resistant gaskets.

- E. Meet UL cold impact test to minus 35 degrees C.
- F. Manufacturer: Hoffman.

2.8 PRECAST HANDHOLES

- A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.
- B. Loading: AASHTO, H-20 in accordance with ASTM C857.
- C. Drainage:
 - 1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
 - 2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.
- D. Raceway Entrances:
 - 1. Provide on all four sides.
 - 2. Provide knockout panels or precast individual raceway openings.
 - 3. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.
- E. Embedded Pulling Iron:
 - 1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.
 - 2. Location:
 - a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
 - b. Floor: Centered below manhole or handhole cover.
- F. Handhole Frames and Covers:
 - 1. Material: Steel, hot-dipped galvanized.
 - 2. Cover Type: Solid, bolt-on, torsion spring, of diamond design.
 - 3. Cover Loading: AASHTO H-20.
 - 4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
 - 5. 600 Volts and Below: ELECTRIC LV, CONTROL, SIGNAL, TELEPHONE.
- G. Hardware: Steel, hot-dip galvanized.
- H. Furnish knockout for ground rod in each handhole.
- I. Manufacturers:
 - 1. Oldcastle Precast.
 - 2. Penn-Cast Products, Inc.
 - 3. Concrete Conduit Co.
 - 4. Associated Concrete Products, Inc.
 - 5. Pipe, Inc.

2.9 PRECAST VAULTS

- A. Use and Dimensions: As shown on Drawings.
- B. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.
- C. Loading: AASHTO, H-20 in accordance with ASTM C857.
- D. Drainage:
 - 1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
 - 2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.
- E. Raceway Entrances:
 - 1. Provide on all four sides.
 - 2. Provide knockout panels or precast individual raceway openings.

3. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.
- F. Embedded Pulling Iron:
1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.
 2. Location:
 - a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
 - b. Floor: Centered below vault or handhole cover.
- G. Cable Racks:
1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving vault, including spares.
 2. Wall Attachment:
 - a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
 - b. Insert Spacing: Maximum 3 feet on center for inside perimeter of vault.
 - c. Arrange in order that spare raceway ends are clear for future cable installation.
- H. Access Frames and Covers:
1. Material: Steel, hot-dipped galvanized.
 2. Cover Type: Pentahead locking latch, hot-dip galvanized diamond design, recessed lifting handle, spring assisted.
 3. Cover Loading: AASHTO H-20.
 4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
 5. Above 600 Volts: ELECTRIC HV.
 6. Below 600 Volts: ELECTRIC LV.
- I. Hardware: Steel, hot-dip galvanized.
- J. Furnish knockout for ground rod in each handhole.
- K. Manufacturers:
1. Amcor.
 2. Idaho Precast.

2.10 ACCESSORIES

- A. Duct Bank Spacers:
1. Modular Type:
 - a. Nonmetallic, interlocking, for multiple conduit sizes.
 - b. Suitable for all types of conduit.
 - c. Manufacturers:
 - 1) Underground Device, Inc.
 - 2) Carlon.
 2. Template Type:
 - a. Nonmetallic, custom made one-piece spacers.
 - b. Suitable for all types of conduit.
 - c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
 - d. Conduit openings cut 1 inch larger than conduit outside diameter.
 - e. Additional openings for stake-down, rebar, and concrete flow through as required.
 - f. Manufacturer and Product: SP Products; Quik Duct.
- B. Identification Devices:
1. Raceway Tags:
 - a. Material: Laminated phenolic.
 - b. Raceway Designation: Pressure stamped, embossed, or engraved.
 - c. Tags relying on adhesives or taped-on markers not permitted.
 2. Warning Tape:

- a. Material: Polyethylene, 4-mil gauge with detectable strip.
- b. Color: Red.
- c. Width: Minimum 3 inches.
- d. Designation: Warning on tape that electric circuit is located below tape.
- e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
- f. Manufacturers and Products:
 - 1) Panduit; Type HTDU.
 - 2) Reef Industries; Terra Tape.
- 3. Buried Raceway Marker:
 - a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
 - b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
 - c. Minimum Dimension: 1/4-inch-thick, 10 inches long, and 3/4 inch wide.
- C. Raceway Coating: Clean and paint.
- D. Heat Shrinkable Tubing:
 - 1. Material: Heat-shrinkable, cross-linked polyolefin.
 - 2. Semi-flexible with meltable adhesive inner liner.
 - 3. Color: Black.
 - 4. Manufacturers:
 - a. Raychem.
 - b. 3M.
- E. Wraparound Duct Band:
 - 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
 - 2. Width: 50 mm minimum.
 - 3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conduit and tubing sizes shown are based on use of copper conductors.
- B. Comply with NECA Installation Standards.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- H. Group raceways installed in same area.
- I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

- L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.
- M. Install watertight fittings in outdoor, underground, or wet locations.
- N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- P. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.
- Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.2 REUSE OF EXISTING CONDUITS

- A. Where Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.
 - 1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
 - 2. Conduit is sized per the NEC.
 - 3. Conduit is of the type specified in Contract Documents.
 - 4. Conduit is supported as specified in Contract Documents.
- B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4 inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.

3.3 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum Cover: 2 inches, including fittings.
- B. Conduit placement shall not require changes in reinforcing steel location or configuration.
- C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
- D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Engineer.
- E. Slabs and Walls (Requires Engineer Approval):
 - 1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
 - 2. Install within middle two-fourths of slab or wall.
 - 3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise allowed by Engineer.
 - 4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise allowed by Engineer.
 - 5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1.5 inch.
 - 6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
 - 7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
- F. Columns and Beams (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.4 CONDUIT APPLICATION

- A. Diameter:
 1. Exposed or aboveground concealed: Minimum $\frac{3}{4}$ inch.
 2. Direct buried or concrete-encased duct bank: Minimum 1 inch.
- B. Exterior, Exposed: PVC-coated rigid galvanized steel.
- C. Interior, Exposed:
 1. Dry areas: Rigid galvanized steel or intermediate metal conduit up to 6 feet above grade. Electric metallic tubing above 6 feet.
 2. Process areas and wet areas: PVC-coated rigid galvanized steel.
- D. Interior, Concealed (Not Embedded in Concrete): Rigid galvanized steel, intermediate metal conduit, or electric metallic tubing.
- E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: PVC Schedule 40.
- F. Direct Earth Burial: PVC Schedule 40.
 1. 90-Degree Bends: PVC-coated rigid steel.
- G. Concrete-Encased Raceways: PVC Schedule 40, except where rigid galvanized steel is indicated.
- H. Under Slabs-On-Grade: PVC Schedule 40.
- I. Transition from Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.
- J. Under Equipment Mounting Pads: Rigid galvanized steel conduit.
- K. Exterior Light Pole Foundations: PVC Schedule 40.
- L. Corrosive Areas: PVC-coated rigid galvanized steel.
- M. Hazardous Gas Areas: PVC-coated rigid galvanized steel.

3.5 FLEXIBLE CONNECTIONS

- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:
 1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
 2. Conduit Size Over 4 Inches: Nonflexible.
 3. Wet or Corrosive Areas: Flexible, nonmetallic or flexible metal liquid-tight.
 4. Dry Areas: Flexible, nonmetallic liquid-tight.
 5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.
- B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, liquid-tight conduit.
- C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.
- D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.6 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.

- C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating as specified in Section 26 05 04, Basic Electrical Materials and Methods.
- D. Apply a single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.
- E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.
- F. Entering Structures:
 - 1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
 - 2. Concrete Roof or Membrane Waterproofed Wall or Floor:
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
 - 3. Heating, Ventilating, and Air Conditioning Equipment:
 - a. Penetrate equipment in area established by manufacturer.
 - b. Terminate conduit with flexible metal conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
 - c. Seal penetration with sealant.
 - 4. Corrosive-Sensitive Areas:
 - a. Seal conduit passing through acetic acid room walls.
 - b. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
 - c. Seal penetration with sealant.
 - 5. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
 - 6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
 - 7. Handholes:
 - a. Metallic Raceways: Provide insulated grounding bushings.
 - b. Nonmetallic Raceways: Provide bell ends flush with wall.
 - c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.7 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 8 feet in any application. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 20 percent extra space for future conduit.
- C. Application/Type of Conduit Strap:
 - 1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
 - 2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 - 3. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 - 1. Wood: Wood screws.
 - 2. Hollow Masonry Units: Toggle bolts.

3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 4. Steelwork: Machine screws.
 5. Location/Type of Hardware:
 - a. Dry, Noncorrosive Areas: Galvanized.
 - b. Wet, Noncorrosive Areas: Stainless steel.
 - c. Corrosive Areas: Stainless steel.
- E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.8 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
 1. Bends 30 Degrees and Larger: Provide factory-made elbows.
 2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
 3. Use manufacturer's recommended method for forming smaller bends.
- H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.9 EXPANSION/DEFLECTION FITTINGS

- A. Provide on raceways at structural expansion joints and in long tangential runs.
- B. Provide expansion/deflection joints for 25 degrees F maximum temperature variation.
- C. Install in accordance with manufacturer's instructions.

3.10 PVC CONDUIT

- A. Solvent Welding:
 1. Apply manufacturer recommended solvent to joints.
 2. Install in order that joint is watertight.
- B. Adapters:
 1. PVC to Metallic Fittings: PVC terminal type.
 2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
- C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

3.11 PVC-COATED RIGID STEEL CONDUIT

- A. Install in accordance with manufacturer's instructions.
- B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.
- C. Provide PVC boot to cover exposed threading.

3.12 WIREWAYS

- A. Install in accordance with manufacturer's instructions.
- B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.
- C. Applications:
 - 1. Metal wireway in indoor dry locations.
 - 2. Nonmetallic wireway in indoor process/wet, outdoor, and corrosive locations.

3.13 TERMINATION AT ENCLOSURES

- A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
- B. Nonmetallic, Cabinets, and Enclosures:
 - 1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
 - 2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.
- C. Sheet Metal Boxes, Cabinets, and Enclosures:
 - 1. General:
 - a. Install insulated bushing on ends of conduit where grounding is not required.
 - b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
 - d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
 - e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
 - 2. Rigid Galvanized Steel and Intermediate Metal Conduit:
 - a. Provide one lock nut each on inside and outside of enclosure.
 - b. Install grounding bushing at source enclosure.
 - c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
 - 3. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
 - 4. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
 - 5. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
 - 6. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.
- D. Motor Control Center, Switchgear, and Free-Standing Enclosures:
 - 1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
 - 2. Terminate PVC conduit entering bottom with bell end fittings.

3.14 UNDERGROUND RACEWAYS

- A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
- B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.
- C. Make routing changes as necessary to avoid obstructions or conflicts.
- D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
- E. Union type fittings not permitted.

- F. Spacers:
 1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
 2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
- G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.
- H. Transition from Underground to Exposed: PVC-coated rigid steel conduit.
- I. Installation with Other Piping Systems:
 1. Crossings: Maintain minimum 12-inch vertical separation.
 2. Parallel Runs: Maintain minimum 12-inch separation.
 3. Installation over valves or couplings not permitted.
- J. Metallic Raceway Coating: Apply wherever rigid galvanized or intermediate metal conduit raceways are specified in direct burial installation. Along entire length, coat with raceway coating or apply tape with one-half tape width overlap to obtain two complete layers.
- K. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.
- L. Provide expansion/deflection fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.
- M. Backfill:
 1. As specified in Division 31 specifications. Controlled low strength fill is an acceptable bedding and pipe zone material. Backfill material to within 12 inches of surface.
 2. Do not backfill until inspected by Engineer and Owner.

3.15 UNDER SLAB RACEWAYS

- A. Make routing changes as necessary to avoid obstructions or conflicts.
- B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.
- C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.
- D. Raceway spacing, in a single layer or multiple layers:
 1. 3 inches clear between adjacent 2-inch or larger raceway.
 2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.
- E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone.
- F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.
- G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.
- H. Fittings:
 1. Union type fittings are not permitted.
 2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
 3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.16 OUTLET AND DEVICE BOXES

- A. General:
 - 1. Install plumb and level.
 - 2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
 - 3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
 - 4. Install galvanized mounting hardware in industrial areas.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
 - 2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
 - 3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.
- C. Locations:
 - 1. Drawing locations are approximate.
 - 2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
 - 3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.
- D. Mounting Height:
 - 1. General:
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
 - c. Do not straddle CMU block or other construction joints.
 - 2. Light Switch:
 - a. 48 inches above floor.
 - b. When located next to door, install on lock side of door.
 - 3. Thermostat: 56 inches above floor.
 - 4. Telephone Outlet:
 - a. 18 inches above floor.
 - b. 6 inches above counter tops.
 - c. Wall Mounted: 48 inches above floor.
 - 5. Convenience Receptacle:
 - a. General Interior Areas: 18 inches above floor.
 - b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 - d. Outdoor Areas: 24 inches above finished grade.
 - 6. Special-Purpose Receptacle: 48 inches above floor or as shown.
 - 7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.
- E. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
 - 3. Holes in surrounding surface shall be no larger than required to receive box.
- F. Supports:
 - 1. Support boxes independently of conduit by attachment to building structure or structural member.

2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
 3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
 4. Provide plaster rings where necessary.
 5. Boxes embedded in concrete or masonry need not be additionally supported.
- G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.
- H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.17 JUNCTION AND PULL BOXES

- A. General:
1. Install plumb and level.
 2. Installed boxes shall be accessible.
 3. Do not install on finished surfaces.
 4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
 5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
 6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
 7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
 8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- B. Flush Mounted:
1. Install with concealed conduit.
 2. Holes in surrounding surface shall be no larger than required to receive box.
 3. Make edges of boxes flush with final surface.
- C. Mounting Hardware:
1. Noncorrosive Dry Areas: Galvanized.
 2. Noncorrosive Wet Areas: Stainless steel.
 3. Corrosive Areas: Stainless steel.
- D. Supports:
1. Support boxes independently of conduit by attachment to building structure or structural member.
 2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
 3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
 4. Boxes embedded in concrete or masonry need not be additionally supported.
- E. At or Below Grade:
1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
 2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.

3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
 4. Use boxes and covers suitable to support anticipated weights.
- F. Install Drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

3.18 HANDHOLES

- A. Excavate, shore, brace, backfill, and final grade in accordance with Division 31 specifications.
- B. Do not install until final raceway grading has been determined.
 1. Provide concrete curb a minimum of 1-foot around handhole frame and cover.
 2. Slope concrete curb to grade away from handhole frame and cover leaving no pockets or other nondraining areas.
- C. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.
- D. Grounding: As specified in Section 26 05 26, Grounding
- E. Identification: Field stamp covers with handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.19 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull tab for underground raceways with end bells.
- C. Provide one No. 12 stranded copper ground wire in each empty conduit for utilization as pull cord and tracer wire.
- D. Identify, as specified in Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.20 IDENTIFICATION DEVICES

- A. Raceway Tags:
 1. Identify per Raceway Schedule designation.
 2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
 3. Install tags at each terminus for concealed raceways.
 4. Provide noncorrosive wire for attachment.
- B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.
- C. Buried Raceway Marker:
 1. Install at grade to indicate direction of underground raceway.
 2. Install at bends and at intervals not exceeding 100 feet in straight runs.
 3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.21 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

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SECTION 26 05 73
ELECTRICAL SYSTEMS ANALYSIS

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. 1584, Guide for Performing Arc Flash Hazard Calculations.
 3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.2 SCOPE

- A. The Contractor shall perform the following:
1. Data collection required for Engineer to complete the Power System Study requirements specified herein for arc flash, short circuit, and coordination studies.
 2. Provide information on data collection forms included herein, and additional information as required for Engineer to complete the Power System Study. Data collection form information includes, but is not limited to, equipment types and nameplate data; all services and feeders including size and type of conductors, conduit types, and lengths; overcurrent protection device information including actual catalog numbers, ratings, and available trip settings; transformer information including type, connections, power ratings, and impedance; load nameplate data.
 3. Deliver completed data collection forms as specified herein to the Engineer 90 days prior to Project Substantial Completion to be utilized by the Engineer to develop a Power System Study Report.
 4. Initially set protective devices to maximum settings during equipment installation, or as recommended by manufacturer.
 5. Adjust protective device settings based on Engineer-furnished Power System Study Report results prior to Project Substantial Completion.
 6. Install Engineer-furnished arc flash warning labels on switchboards, motor control centers, panel boards, VFD's, disconnect switches, and other applicable new power system elements prior to Project Substantial Completion.
- B. The Engineer shall perform the following:
1. Prepare a Power System Study Report that includes arc flash, short circuit, and coordination studies for switchboards, motor control centers, panel boards, and other applicable new power system elements. The studies and report will be based on as-installed equipment, circuit, and raceway data collection form information provided by the Contractor to the Engineer.
 2. Deliver final protective device settings and arc flash labels to the Contractor 14 days prior to Project Substantial Completion.

1.3 POWER SYSTEM STUDY PERFORMED BY ENGINEER

A. General:

1. Perform studies using SKM Power Tools for Windows.
2. Perform complete fault calculations for each source combination, which may include present and future power company supply circuits, large motors, or generators.
3. Utilize data for study obtained from Contractor's field investigation of system configuration, wiring information, and equipment.
4. Existing System and Equipment:
 - a. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
 - b. Include fault contribution of existing motors and equipment in study.
 - c. Include impedance elements that affect new system and equipment.
 - d. Include protective devices in series with new equipment.
5. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

B. Power System Study includes:

1. Short Circuit Study
2. Protective Device Coordination Study
3. Arc Flash Study

PART 2 - PRODUCTS

2.1 ARC FLASH WARNING LABELS

- A. The Engineer will provide the Contractor adhesive backed labels for installation by Contractor.

2.2 DATA COLLECTION FORMS

- A. Examples of data collection forms are located following end of section. Contractor shall coordinate with the Engineer if collection form modifications are required to accommodate differing circumstances or unlisted equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of required major equipment modifications.
- D. Install Engineer-provided arc flash warning labels on equipment as required by code.

3.2 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is a part of this Specification:
1. Data collection form – Panelboard.
 2. Data collection form – Low Voltage MCC (main circuit breaker).
 3. Data collection form – Low Voltage MCC (feeder circuit breaker or motor controller unit).
 4. Data collection form – Dry Type Transformer.
 5. Data collection form – Switchboard (main circuit breaker).
 6. Data collection form – Switchboard (feeder circuit breaker).

END OF SECTION

DATA COLLECTION FORM

PANELBOARD

PANEL ID OR TAG #:

FED FROM:

MANUFACTURER:

PART #:

VOLTAGE:

SHORT CIRCUIT CURRENT RATING (SSCR):

PANELBOARD CONNECTION:

MAIN CIRCUIT BREAKER MANUFACTURER:

MAIN CIRCUIT BREAKER PART #:

MAIN CIRCUIT BREAKER AMPACITY:

MAGNETIC TRIP SETTING (IF APPLICABLE):

ARC FLASH REDUCTION MAINTENANCE SYSTEM MANUFACTURER AND PART NUMBER:

WIRE SIZE FROM SOURCE:

WIRE LENGTH FROM SOURCE:

CONDUIT SIZE:

NOTES:

DATA COLLECTION FORM

LOW-VOLTAGE MCC (MAIN CIRCUIT BREAKER)

MCC ID OR TAG #:

FED FROM (SOURCE):

MCC MANUFACTURER:

MCC PART #:

VOLTAGE:

SHORT CIRCUIT CURRENT RATING (SSCR):

CIRCUIT BREAKER MANUFACTURER AND PART #:

FRAME SIZE:

INTERRUPTING RATING:

ADJUSTABLE MAGNETIC PICKUP:

RATING PLUG:

TRIP UNIT PROTECTIVE PROGRAMMER MANUFACTURER AND PART NUMBER:

ARC FLASH REDUCTION MAINTENANCE SYSTEM MANUFACTURER AND PART NUMBER:

WIRE SIZE FROM SOURCE:

NUMBER OF PARALLEL RUNS:

WIRE LENGTH:

CONDUIT SIZE(S):

DATA COLLECTION FORM

LOW VOLTAGE MCC (FEEDER CIRCUIT BREAKER OR MOTOR CONTROLLER UNITS)

MCC ID OR TAG #:

FEEDER BREAKER MANUFACTURER AND PART #:

FRAME SIZE:

INTERRUPTING RATING:

ADJUSTABLE MAGNETIC PICKUP:

CIRCUIT BREAKER RATING PLUG:

TRIP UNIT PROTECTIVE PROGRAMMER MANUFACTURER AND PART NUMBER:

ARC FLASH REDUCTION MAINTENANCE SYSTEM MANUFACTURER AND PART NUMBER:

MOTOR STARTER UNIT PART #:

MOTOR STARTER SIZE:

OVERLOAD RELAY SETTING (>40HP):

ADDITIONAL MOTOR STARTER INFO:

LOAD SERVED:

LOAD ID OR TAG #:

LOAD NAMEPLATE DATA AND TYPE:

WIRE SIZE TO LOAD:

NUMBER OF PARALLEL RUNS:

WIRE LENGTH:

CONDUIT SIZE(S):

NOTES:

DATA COLLECTION FORM
DRY-TYPE TRANSFORMER

TRANSFORMER ID OR TAG #:

FED FROM:

MANUFACTURER:

NAMEPLATE DATA:

KVA:

PRIMARY VOLTAGE:

PRIMARY CONNECTION (DELTA OR WYE-GND):

SECONDARY VOLTAGE:

SECONDARY CONNECTION (WYE-GND):

IMPEDANCE:

PRIMARY TAP SETTING:

PRIMARY WIRE SIZE:

PRIMARY WIRE LENGTH:

PRIMARY CONDUIT SIZE:

SECONDARY WIRE SIZE:

SECONDARY WIRE LENGTH:

SECONDARY CONDUIT SIZE:

NOTES:

DATA COLLECTION FORM
SWITCHBOARD (MAIN CIRCUIT BREAKER)

SWITCHGEAR ID OR TAG #:

FED FROM (SOURCE):

MANUFACTURER:

PART #:

VOLTAGE:

SHORT CIRCUIT CURRENT RATING (SSCR):

CIRCUIT BREAKER MANUFACTURER AND PART #:

FRAME SIZE:

INTERRUPTING RATING:

RATING PLUG:

LONG TIME PICKUP:

INSTANTANEOUS PICKUP:

SHORT TIME PICKUP:

SHORT TIME DELAY:

GROUND FAULT PICKUP:

GROUND FAULT DELAY:

ARC FLASH REDUCTION MAINTENANCE SYSTEM MANUFACTURER AND PART NUMBER:

WIRE SIZE AND TYPE FROM SOURCE:

NUMBER OF PARALLEL RUNS:

WIRE LENGTH:

CONDUIT SIZE(S):

NOTES:

DATA COLLECTION FORM
SWITCHBOARD (FEEDER CIRCUIT BREAKER)

SWITCHBOARD ID OR TAG #:

CIRCUIT BREAKER MANUFACTURER AND PART #:

FRAME SIZE:

INTERRUPTING RATING:

ADJUSTABLE MAGNETIC PICKUP:

RATING PLUG:

LONG TIME PICKUP:

INSTANTANEOUS PICKUP:

SHORT TIME PICKUP:

SHORT TIME DELAY:

GROUND FAULT PICKUP:

GROUND FAULT DELAY:

ARC FLASH REDUCTION MAINTENANCE SYSTEM MANUFACTURER AND PART NUMBER:

LOAD SERVED:

LOAD ID OR TAG #:

LOAD SIZE AND TYPE:

WIRE SIZE AND TYPE TO LOAD:

NUMBER OF PARALLEL RUNS:

WIRE LENGTH:

CONDUIT SIZE(S):

NOTES:

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

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):
 - a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
 - b. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - c. C2, National Electrical Safety Code.
 - d. C37.20.1, Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
 - e. C62.33, Standard Test Specifications for Varistor Surge-Protective Devices.
 2. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
 3. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70B, Recommended Practice for Electrical Equipment Maintenance.
 - c. 70E, Standard for Electrical Safety in the Workplace.
 - d. 101, Life Safety Code.
 5. National Institute for Certification in Engineering Technologies (NICET).
 6. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.2 SUBMITTALS

- A. Informational Submittals:
1. Submit 30 days prior to performing inspections or tests:
 - a. Schedule for performing inspection and tests.
 - b. List of references to be used for each test.
 - c. Sample copy of equipment and materials inspection form(s).
 - d. Sample copy of individual device test form.
 - e. Sample copy of individual system test form.
 2. Energization Plan: Prior to initial energization of electrical distribution equipment; include the following:
 - a. Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
 - b. Staged sequence of initial energization of electrical equipment.
 - c. Lock-Out-Tag-Out plan for each stage of the progressive energization.
 - d. Barricading, signage, and communication plan notifying personnel of newly energized equipment.
 3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
 4. Operation and Maintenance Data:
 - a. In accordance with Section 01 78 23, Operation and Maintenance Manuals.
 - b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.

5. Programmable Settings: At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files on compact disc of as-left set points, programs, and device configuration files for:
 - a. Protective relays
 - b. Intelligent overload relays.
 - c. Variable frequency drives.
 - d. Power metering devices.

1.3 QUALITY ASSURANCE

- A. Testing Firm Qualifications:
 1. Corporately and financially independent organization functioning as an unbiased testing authority.
 2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
 3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
 4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years' testing experience on similar projects.
 5. Technicians certified by NICET or NETA.
 6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
 7. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.
- B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.
- C. Test instrument calibration shall be in accordance with NETA ATS.

1.4 SEQUENCING AND SCHEDULING

- A. Perform inspection and electrical tests after equipment listed herein has been installed.
- B. Perform tests with apparatus de-energized whenever feasible.
- C. Inspection and electrical tests on energized equipment shall be:
 1. Scheduled with Engineer prior to de-energization.
 2. Minimized to avoid extended period of interruption to the operating plant equipment.
- D. Notify Engineer at least 24 hours prior to performing tests on energized electrical equipment.
- E. Manufacturer's Services: The services of qualified manufacturer's representatives have been specified for testing under certain specification sections. Coordinate and employ those services as required to provide complete testing in accordance with this section and the manufacturer's recommendations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Perform tests in accordance with requirements of Section 01 75 00, Checkout and Start-up Procedures.
- B. Tests and inspections shall establish:
 1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
 2. Installation operates properly.

3. Equipment is suitable for energization.
 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
 - D. Set, test, and calibrate protective relays, circuit breakers, fuses, power monitoring meters and other applicable devices in accordance with values established by short circuit, coordination, and harmonics studies as specified in Section 26 05 73, Electrical Systems Analysis.
 - E. Adjust mechanisms and moving parts of equipment for free mechanical movement.
 - F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
 - G. Verify nameplate data for conformance to Contract Documents and approved Submittals.
 - H. Realign equipment not properly aligned and correct unlevelness.
 - I. Properly anchor electrical equipment found to be inadequately anchored.
 - J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.
 - K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
 - L. Provide proper lubrication of applicable moving parts.
 - M. Inform Engineer of working clearances not in accordance with NFPA 70.
 - N. Investigate and repair or replace:
 1. Electrical items that fail tests.
 2. Active components not operating in accordance with manufacturer's instructions.
 3. Damaged electrical equipment.
 - O. Electrical Enclosures:
 1. Remove foreign material and moisture from enclosure interior.
 2. Vacuum and wipe clean enclosure interior.
 3. Remove corrosion found on metal surfaces.
 4. Repair or replace, as determined by Engineer, door and panel sections having dented surfaces.
 5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
 6. Repair or replace improperly operating latching, locking, or interlocking devices.
 7. Replace missing or damaged hardware.
 8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required because of extensive damage, as determined by Engineer, refinish entire assembly.
 - P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.2 CHECKOUT AND STARTUP

- A. Voltage Field Test:
 1. Check voltage at point of termination of power company supply system to Project when installation is essentially complete and is in operation.
 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
 3. Unbalance Corrections:

- a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
 - b. Obtain written certification from responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.
- B. Equipment Line Current Tests:
- 1. Check line current in each phase for each piece of equipment.
 - 2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
 - 3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.3 SWITCHBOARD ASSEMBLIES

- A. Visual and Mechanical Inspection:
- 1. Insulator damage and contaminated surfaces.
 - 2. Proper barrier and shutter installation and operation.
 - 3. Proper operation of indicating devices.
 - 4. Improper blockage of air-cooling passages.
 - 5. Proper operation of draw out elements.
 - 6. Integrity and contamination of bus insulation system.
 - 7. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
 - 8. Check key interlocking systems for:
 - a. Key captivity when device is in ON or CLOSED position.
 - b. Key removal when device is in ON or CLOSED position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.
 - e. Existence of Other Keys Capable of Operating Lock Cylinders: Destroy duplicate sets of keys.
 - 9. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. All devices
 - 10. Verify fuse and circuit breaker ratings, sizes, and types conform to those specified.
 - 11. Check bus and cable connections for high resistance by calibrated torque wrench applied to bolted joints.
 - a. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 - 12. Check operation and sequencing of electrical and mechanical interlock systems by:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
 - 13. Verify performance of each control device and feature.
 - 14. Control Wiring:
 - a. Compare wiring to local and remote control and protective devices with elementary diagrams.
 - b. Proper conductor lacing and bundling.
 - c. Proper conductor identification.
 - d. Proper conductor lugs and connections.
 - 15. Exercise active components.
 - 16. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.

- B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. With breakers open.
 - e. With breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Control Wiring:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal boards and each device terminal.
3. Operational Test:
 - a. Initiate control devices.
 - b. Check proper operation of control system in each section.

3.4 PANELBOARDS

- A. Visual and Mechanical Inspection: Include the following inspections and related work:
 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 3. Check panelboard mounting, area clearances, and alignment and fit of components.
 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 5. Perform visual and mechanical inspection for overcurrent protective devices.
- B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:
 1. Ground continuity test ground bus to system ground.

3.5 DRY TYPE TRANSFORMERS

- A. Visual and Mechanical Inspection:
 1. Physical and insulator damage.
 2. Proper winding connections.
 3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 4. Defective wiring.
 5. Proper operation of fans, indicators, and auxiliary devices.
 6. Removal of shipping brackets, fixtures, or bracing.
 7. Free and properly installed resilient mounts.
 8. Cleanliness and improper blockage of ventilation passages.
 9. Verify tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
 10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.
- B. Electrical Tests:
 1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - c. Results temperature corrected in accordance with NETA ATS, Table 100.14.

- d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
- e. Insulation resistance test results to compare within 1 percent of adjacent windings.
- 2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.6 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

- A. Visual and Mechanical Inspection:
 - 1. Inspect each individual exposed power cable No. 4 and larger for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with specification.
 - e. Proper circuit identification.
 - 2. Mechanical Connections for:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 - 3. Shielded Instrumentation Cables for:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
 - 4. Control Cables for:
 - a. Proper termination.
 - b. Proper circuit identification.
 - 5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.
- B. Electrical Tests for Conductors No. 4 and Larger:
 - 1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
 - b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
 - c. Evaluate ohmic values by comparison with conductors of same length and type.
 - d. Investigate values less than 50 megohms.
 - 2. Continuity test by ohmmeter method to ensure proper cable connections.

3.7 FIBER-OPTIC CABLES

- A. Visual and mechanical inspection:
 - 1. Compare cable, connector, and splice data with the Contract Documents.
 - 2. Inspect cable and connections for physical and mechanical damage.
 - 3. Verify that all connectors and splices are correctly installed.
- B. Electrical tests:
 - 1. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer (OTDR):
 - a. OTDR test performed on fiber cables less than 100 meters shall be performed with the aid of a launch cable.
 - b. Adjust OTDR pulse width settings to a maximum setting of 1/1,000th of the cable length or 10nanoseconds.
 - 2. Perform connector and splice integrity test using an optical time domain reflectometer.
 - 3. Perform cable attenuation loss measurement with an optical power loss test set:
 - a. Perform attenuation tests with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum.
 - b. Test multimode fibers at 850 nanometer and 1,300 nanometer.

- c. Test single mode fibers at 1,310 nanometer and 1,550 nanometers.
- 4. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set:
 - a. At the conclusion of all outdoor splices at 1 location, and before they are enclosed and sealed, all splices shall be tested with OTDR at the optimal wavelengths (850 and 1,300 for multimode, 1,310 and 1,550 for single mode), in both directions. The splices shall be tested for integrity as well as attenuation.
- 5. Perform fiber links integrity and attenuation tests using each link shall be an OTDR and an Optical Loss Test Set:
 - a. OTDR traces shall be from both directions on each fiber at the 2 optimal wavelengths, 850 nanometer, and 1,300 nanometer for multimode fibers.
 - b. Optical loss testing shall be done with handheld test sets in 1 direction at the 2 optimal wavelengths for the appropriate fiber type. Test equipment shall equal or exceed the accuracy and resolution of Agilent/HP 8147 high performance OTDR.
- C. Test values:
 - 1. Cable and connections shall not have been subjected to physical or mechanical damage.
 - 2. Connectors and splices shall be installed in accordance with industry standards.
 - 3. The optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.
 - 4. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.
 - 5. Individual fusion splice losses shall not exceed 0.1 dB. Measurement results shall be recorded, validated by trace, and filed with the records of the respective cable runs.

3.8 NETWORK CABLES

- A. Visual and mechanical inspections:
 - 1. Compare cable type and connections with that indicated on the Drawings and specified in the Specifications.
 - 2. Inspect cable and connectors for physical and mechanical damage.
 - 3. Verify that all connectors are correctly installed.
- B. Pre-testing:
 - 1. Test individual cables before installation:
 - a. Before physical placement of the cable, test each cable while on the spool with a LAN certification test device.
 - b. Before the cable is installed, verify that the cable conforms to the manufacturer's attenuation specification and that no damage has been done to the cable during shipping or handling.
 - c. The test shall be fully documented and the results submitted to the Engineer, including a hard copy of all traces, before placement of the cable.
 - d. The Engineer shall be notified if a cable fails to meet specification and the cable shall not be installed unless otherwise directed by the Engineer.
- C. Electrical tests:
 - 1. Perform cable end-to-end testing on all installed cables after installation of connectors from both ends of the cable.
 - 2. Test shall include cable system performance tests and confirm the absence of wiring errors.
- D. Test results:
 - 1. Cables shall meet or exceed TIA standards for a Category 6a installation.
- E. Test equipment:
 - 1. LAN certification equipment used for the testing shall be capable of testing Category 6 cable installation to TIA proposed Level III accuracy. Tests performed shall include:
 - a. Near end cross talk.
 - b. Attenuation.

- c. Equal level far end cross talk.
 - d. Return loss.
 - e. Ambient noise.
 - f. Effective cable length.
 - g. Propagation delay.
 - h. Continuity/loop resistance.
2. LAN certification test equipment shall be able to store and produce plots of the test results.
 3. Acceptable manufacturers: The following or equal:
 - a. Agilent Technologies, WireScope 350.

3.9 SAFETY SWITCHES, 600 VOLTS MAXIMUM

- A. Visual and Mechanical Inspection:
 1. Proper blade pressure and alignment.
 2. Proper operation of switch operating handle.
 3. Adequate mechanical support for each fuse.
 4. Proper contact-to-contact tightness between fuse clip and fuse.
 5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
 6. Proper phase barrier material and installation.
 7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
 8. Perform mechanical operational test and verify mechanical interlocking system operation and sequencing.

3.10 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

- A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 100 amperes and larger.
- B. Visual and Mechanical Inspection:
 1. Proper mounting.
 2. Proper conductor size.
 3. Feeder designation according to nameplate and one-line diagram.
 4. Cracked casings.
 5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
 6. Operate breaker to verify smooth operation.
 7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
 8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.
- C. Electrical Tests:
 1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 100.1.
 2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
 3. Primary Current Injection Test to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS, Table 100.7.
 - g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS, Table 100.8.

3.11 LOW VOLTAGE POWER CIRCUIT BREAKERS

- A. Visual and Mechanical Inspection:
 - 1. Proper mounting, cell fit, and element alignment.
 - 2. Proper operation of racking interlocks.
 - 3. Check for damaged arc chutes.
 - 4. Proper contact condition.
 - 5. Bolt torque level in accordance with NETA ATS, Table 100.12.
 - 6. Perform mechanical operational and contact alignment tests in accordance with manufacturer's instructions.
 - 7. Check operation of closing and tripping functions of trip devices by activating ground fault relays, undervoltage shunt relays, and other auxiliary protective devices.
 - 8. Verify primary and secondary contact wipe, gap setting, and other dimensions vital to breaker operation are correct.
 - 9. Check charging motor, motor brushes, associated mechanism, and limit switches for proper operation and condition.
 - 10. Check operation of electrically operated breakers in accordance with manufacturer's instructions.
 - 11. Check for adequate lubrication on contact, moving, and sliding surfaces.
- B. Electrical Tests:
 - 1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 100.1.
 - 2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
 - 3. Primary Current Injection Test to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristic when adjusted to setting sheet parameters shall be within manufacturer's published time-current tolerance band.

3.12 INSTRUMENT TRANSFORMERS

- A. Visual and Mechanical Inspection:
 - 1. Visually check current, potential, and control transformers for:
 - a. Cracked insulation.
 - b. Broken leads or defective wiring.
 - c. Proper connections.
 - d. Adequate clearances between primary and secondary circuit wiring.
 - 2. Verify Mechanically:
 - a. Grounding and shorting connections have good contact.
 - b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
 - 3. Verify proper primary and secondary fuse sizes for potential transformers.

3.13 METERING

- A. Visual and Mechanical Inspection:
 - 1. Verify meter connections in accordance with appropriate diagrams.
 - 2. Verify meter multipliers.
 - 3. Verify meter types and scales conform to Contract Documents.
 - 4. Check calibration of meters at cardinal points.
 - 5. Check calibration of electrical transducers.

3.14 GROUNDING SYSTEMS

- A. Visual and Mechanical Inspection:
 - 1. Equipment and circuit grounds in switchboards, motor control centers, and panelboards assemblies for proper connection and tightness.
 - 2. Ground bus connections in switchboards, motor control centers, and panelboards assemblies for proper termination and tightness.
 - 3. Effective transformer core and equipment grounding.
 - 4. Accessible connections to grounding electrodes for proper fit and tightness.
 - 5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.
- B. Electrical Tests:
 - 1. Fall-of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 1 ohm.
 - 2. Two-Point Direct Method Test:
 - a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
 - b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.

3.15 AC INDUCTION MOTORS

- A. General: Inspection and testing limited to motors rated 5 horsepower and larger.
- B. Visual and Mechanical Inspection:
 - 1. Proper electrical and grounding connections.
 - 2. Shaft alignment.
 - 3. Blockage of ventilating air passageways.
 - 4. Operate motor and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionality and proper operation.
 - e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.
 - 5. Check operation of space heaters.
- C. Electrical Tests:
 - 1. Insulation Resistance Tests:
 - a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
 - 1) Motors above 200 horsepower for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - 2) Motors 200 horsepower and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.
 - b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
 - 2. Calculate polarization index ratios for motors above 200 horsepower. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
 - 3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
 - 4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

3.16 VARIABLE FREQUENCY DRIVE SYSTEMS

- A. Visual and Mechanical Inspection:
 - 1. Proper operation of indicating and monitoring devices.
 - 2. Inspect physical and mechanical condition.
 - 3. Improper blockage of air-cooling passages.
 - 4. Inspect anchorage, alignment, and grounding.
 - 5. Integrity and contamination of bus insulation system.
 - 6. Inspect bolted electrical connections for high resistance.
 - 7. Motor running protection:
 - a. Verify drive overcurrent setpoints are correct for their application.
 - b. If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application
 - c. Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor.
 - 8. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. All devices.
 - 9. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
 - 10. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
 - e. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.
 - 11. Exercise active components.
- B. Electrical Tests:
 - 1. Measure harmonic distortion for both voltage and current to verify if within specification limits.
 - 2. Measure peak voltage at motor terminations to verify if less than 90 percent of motor insulation dielectric withstand level.
 - 3. Perform resistance measurements through bolted connections with low-resistance ohmmeter, if applicable.
 - 4. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
 - 5. Test input circuit breaker by primary injection.
 - 6. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts DC for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. Follow manufacturer's recommendations for units with solid-state components.
 - 7. Test for the following parameters in accordance with manufacturer's recommendations:
 - a. Input phase loss protection
 - b. Input overvoltage protection
 - c. Output phase rotation
 - d. Overtemperature protection
 - e. DC overvoltage protection
 - f. Over frequency protection
 - g. Drive overload protection
 - h. Fault alarm outputs
 - 8. Operational test by initiating control devices to affect proper operation.
 - 9. Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

3.17 LOW-VOLTAGE MOTOR CONTROL CENTERS

- A. Visual and Mechanical Inspection:
1. Proper barrier and shutter installation and operation.
 2. Proper operation of indicating and monitoring devices.
 3. Proper overload protection for each motor.
 4. Improper blockage of air-cooling passages.
 5. Proper operation of drawout elements.
 6. Integrity and contamination of bus insulation system.
 7. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
 8. Check key interlocking systems for:
 - a. Key captivity when device is in ON or CLOSED position.
 - b. Key removal when device is in OFF or OPEN position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.
 - e. Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.
 9. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. All devices.
 10. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
 11. Verify current and potential transformer ratios conform to Contract Documents.
 - a. Check bus connections for high resistance by calibrated torque wrench applied to bolted joints: Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
 12. Check operation and sequencing of electrical and mechanical interlock systems by:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
 13. Verify performance of each control device and feature furnished as part of motor control center.
 14. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
 15. Exercise active components.
 16. Inspect contactors for:
 - a. Correct mechanical operations.
 - b. Correct contact gap, wipe, alignment, and pressure.
 - c. Correct torque of connections.
 17. Compare overload rating with full-load current for proper size.
 18. Compare motor protector and circuit breaker with motor characteristics for proper size.
- B. Electrical Tests:
1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
 - c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
 - d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
 - e. Test values to comply with NETA ATS, Table 100.1.

2. Operational test by initiating control devices to affect proper operation.

3.18 SURGE PROTECTIVE DEVICES

- A. Visual and Mechanical Inspection:
 1. Adequate clearances between arrestors and enclosures.
 2. Ground connections to ground bus.
- B. Electrical Tests:
 1. Varistor Type Arrestors:
 - a. Clamping voltage test.
 - b. Rated RMS voltage test.
 - c. Rated dc voltage test.
 - d. Varistor arrestor test values in accordance with IEEE C62.33, Section 4.4 and Section 4.9.

3.19 ACTIVE HARMONIC CONDITIONERS

- A. Visual and Mechanical Inspection:
 1. Inspect equipment for signs of damage
 2. Verify installation per drawings.
 3. Verify current transformer orientation and wiring to power correction system.
 4. Proper connection and grounding.
 5. Verify that fuse types and ratings conform to shop Drawings.
 6. Verify logic setup corresponds to performance specifications.
 7. Check wiring and terminal connections for tightness.
- B. Electrical Tests:
 1. Electrical and functional tests in accordance with manufacturer's instructions.
 2. Functional test of all control and indication devices.
 3. Performance testing: Test shall document specified control of current and voltage harmonic distortion.

END OF SECTION

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SECTION 26 09 13
INSTRUMENT TRANSFORMERS AND METERS

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI)
 - a. ANSI C37.20, Switchgear Assemblies Including Metal-Enclosed Bus
 - b. ANSI C39.1, Requirements for Electrical Analog Indicating Instruments
 - c. ANSI C57.13, Requirements for Instrument Transformers

1.2 SUBMITTALS

- A. Action Submittal Items for this Section:
1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from Section requirements.
 2. Catalog cuts of equipment, devices, and materials installed under this section. Catalog information shall include technical specifications and application information, including electrical ratings, dimensions, weight, etc. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 3. Operation and maintenance items as specified in Section 01 78 23 – Operation and Maintenance Manuals.
 4. Manufacturer's product data with features and dimensions of devices.
 5. Burden, accuracy class, and ratio data for instrument transformers.

PART 2 - PRODUCTS

2.1 INSTRUMENT TRANSFORMERS

- A. Instrument transformers shall be molded dry-type in accordance with ANSI C57.13. Transformer volt-ampere rating shall be suitable for carrying the specified load without overheating or exceeding the permissible accuracy for the transformer.
- B. Current transformers shall be furnished with the specified ratios. The accuracies shall conform to ANSI C37.20. Add shorting terminal blocks for all current transformers.

2.2 POWER MONITOR AND DISPLAY (PMD)

- A. Power monitor and display unit shall be provided where shown on the one-line diagram. The unit shall monitor all three phases and shall display volts (phase to phase and phase to neutral), amperes, power factor, and hertz. The PMD shall be supplied with native Ethernet IP communications port (no exceptions) for internal networking via Ethernet switch within switchgear and motor control centers, and to the plant control network.
- B. Service Entrance Switchboards and Motor Control Centers: Allen Bradley PowerMonitor 5000 model M6 with integral display module, or equivalent.
- C. Main Lug Only Motor Control Centers: Allen Bradley PowerMonitor 500, or equivalent.
- D. Provide blown fuse indicators on all fuses.
- E. Provide current transformers with a minimum of 1% accuracy at 10% of range, and all mounting hardware, including but not limited to, shorting terminal blocks for a complete installation.
- F. Mount the power monitor in the unit door between 54" and 66" above the floor when installed on the house keeping pad.

- G. Power monitors shall be powered at 120V via separately mounted UPS specified and installed in Section 40 98 00 – Control Panels and Enclosures.

2.3 NAMEPLATES

- A. Refer to Section 26 05 00, General Requirements for Electrical Work.

PART 3 - EXECUTION

3.1 GENERAL

- A. Accessories and devices shall be installed per the electrical distribution equipment manufacturer's instructions.
- B. Verify PMD's operate in accordance with manufacturer's instructions.

END OF SECTION

SECTION 26 14 13

SWITCHBOARDS

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. PB 2, Deadfront Distribution Switchboards.
 - b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 3. Underwriters Laboratories (UL):
 - a. 489, Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - b. 891, Standard for Safety for Switchboards.
 - c. 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Descriptive product information.
 - 2. Itemized Bill of Material.
 - 3. Dimensional drawings.
 - 4. Operational description.
 - 5. Anchoring instructions and details.
 - 6. One-line, three-line, and control schematic drawings.
 - 7. Connection and interconnection drawings.
 - 8. Circuit Breakers: Copies of time-current characteristics.
 - 9. Ground Fault Protection: Relay time-current characteristics.
 - 10. Bus data.
 - 11. Incoming line section equipment data.
 - 12. Transformer section equipment data.
 - 13. Conduit entrance locations.
 - 14. Seismic anchorage and bracing drawings and cut sheets.
- B. Informational Submittals:
 - 1. Seismic anchorage and bracing calculations.
 - 2. Manufacturer's installation instructions.
 - 3. Factory Test Report.
 - 4. Operation and Maintenance Data.
 - 5. Manufacturer's Certificate of Proper Installation.

1.3 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 - 1. Eaton
 - 2. General Electric.
 - 3. Siemens.
 - 4. Square D.
- B. Switchboards shall be of the same manufacturer as equipment furnished for low voltage panelboards and low voltage motor control for standardization.

2.2 GENERAL REQUIREMENTS

- A. Service: 480Y/277 volts, three-phase, four-wire, grounded wye having an available short circuit current at line terminals of 65,000 amperes rms symmetrical.
- B. Comply with NEMA PB 2 and UL 891.
- C. Switchboard and its major components shall be end products of one manufacturer in order to achieve standardization for appearance, operation and maintenance, spare parts replacement, and manufacturer's services.
- D. Operating Conditions:
 - 1. Ambient Temperature: Maximum 40 degrees C.
 - 2. Equipment shall be fully rated without derating for operating conditions.
- E. Lifting lugs on equipment and devices weighing over 100 pounds.

2.3 STATIONARY STRUCTURE

- A. Type: NEMA PB 2 construction, dead front, completely metal enclosed, self-supporting.
- B. Sections bolted together to form one rigid assembly capable of being moved into position and bolted directly to floor without use of floor sills.

2.4 ENCLOSURE

- A. Finish: Baked enamel applied over rust-inhibiting phosphated base coating.
 - 1. Color:
 - a. Exterior: Provide ANSI 61 gray finish.
 - b. Interior: White.
 - c. Unpainted Parts: Plated for corrosion resistance.
- B. Indoor Enclosure:
 - 1. NEMA 250, Type 1, fully front accessible.
 - 2. Rear, full-height, bolt-on panels for each enclosure section.
 - 3. Cable Termination Access: Padlock provision.
 - 4. Front Access:
 - a. Service line and load terminations, internal devices, device and bolted bus connections, and protective device removal, serviceable from front only.
 - b. Sections aligned across back to permit placement flush against wall.
 - c. Working Space: As required by NFPA 70.
 - 5. Transition sections as required or shown.
 - 6. Side and Top Covers: Removable, captive, screw-on plates with formed edges on each side.
 - 7. Front Cover: Hinged door with formed edges.

2.5 BUSWORK

- A. Material: Phase insulated silver-plated copper throughout entire length of sufficient cross section to limit temperature rise at rated current to 55 degrees C.

- B. Bus Arrangement: A B C, left-to-right, top-to-bottom, and front-to-rear, as viewed from front.
- C. Brace for short circuit currents 65,000 amperes rms symmetrical.
- D. Main Horizontal Bus: Nontapered, continuous current rating as shown.
- E. Neutral Bus: Continuous current rating 70 percent of main horizontal bus rating.
- F. Ground Bus:
 - 1. Material: Copper.
 - 2. Rating: 500 amperes minimum (short-time withstand rating shall be coordinated with that of the largest circuit breaker in the switchboard assembly).
 - 3. Bolted to each vertical section.
 - 4. Ground lug for 4/0 copper conductor on each end of bus.
 - 5. Bus Connections and Joints: Bolted with Belleville washers.
- G. Extend each bus entire length of switchboard with provision for extension to future units.

2.6 PROTECTIVE DEVICES

- A. Molded-Case Circuit Breakers:
 - 1. Main and Tie Devices: Fixed individually mounted UL 489 listed for 100 percent of continuous ampere rating, suitable for use with 75 degrees C wire at full 75 degrees C ampacity when mounted in switchboard.
 - 2. Feeder Protective Devices: Group mounted, suitable for use with 75-degree C wire at full 75-degree C ampacity when mounted in switchboard.
 - 3. Breakers 225-Ampere Frame and Above: Provide solid state trip unit.
 - 4. Interrupting Rating: 65,000 amperes rms symmetrical at rated voltage.
 - 5. Breakers 2,000- ampere through 3,000-ampere frames shall be UL 489 listed and labeled 100 percent application in accordance with NFPA 70.
 - 6. Mechanical interlock to prevent opening compartment door while breaker is in closed position.

2.7 SOLID STATE TRIP UNITS

- A. Flux-shift trip and current sensors.
- B. Protective Programmers:
 - 1. Self-powered, automatic rms sensing micro-electronic processor.
 - 2. No external relays or accessories.
 - 3. Printed circuit cards with gold-plated contacts.
 - 4. Programmable Controls:
 - a. Fixed-point, with repetitive accuracy and precise unit settings.
 - b. Trip adjustments made by nonremovable, discrete step switching.
 - 5. Field-Installable Rating Plugs:
 - a. Long-time pickup LED indicator and test receptacle.
 - b. Matching load and cable requirements.
 - c. Interlocked with tripping mechanism.
 - d. Breaker to remain trip-free with plug removed.
 - e. Keyed rating plugs to prevent incorrect application.
 - 6. Long-time pickup light.
 - 7. Selective coordination time/current curve shaping adjustable functions:
 - a. Current setting.
 - b. Long-time pickup.
 - c. Long-time delay.
 - d. Instantaneous pickup with short-time for main, tie, and feeders.
 - e. Short-time pickup for main, tie, and feeders.
 - f. Short-time delay for main, tie, and feeders with I2T function, and IN OUT switch.
 - g. Ground fault pickup.
 - h. Ground fault delay with I2T function.

- i. High instantaneous pickup with short-time delay.
- 8. Fault Trip Indicators: LED type for overload and short circuit overload plus ground fault trip.
- 9. Rejection Pins: For each programmer frame size.
- C. Phase Current Sensors:
 - 1. Single-ratio type.
 - 2. Fixed, mounted on breaker frame.
 - 3. Molded epoxy construction.
 - 4. One toroidal type for each phase.
- D. Ground Fault Sensor:
 - 1. Neutral bar single-ratio CT mounted in cable compartment.
 - 2. Molded epoxy construction.
 - 3. Shorting bar.
- E. Portable Test Set: ac/dc static, full function unit for checking programmer's time-current characteristics of programmer.

2.8 ARC FLASH REDUCTION MAINTENANCE SYSTEM.

- A. Provide arc flash reduction maintenance system on all main breakers.
- B. System shall not compromise breaker phase protection when enabled.
- C. Clearing time of 0.04 seconds, adjustable 2.5X to 10X of the sensor value.
- D. Enabled via door mounted lockable lockout/tagout selector switch with confirmation via a blue LED indication lamp.
- E. All indicating lamps shall have an integrated lamp-test function or a common lamp test switch for all lamps.
- F. Provide associated control power transformer as required.

2.9 CONTROL WIRING

- A. NFPA 70, Type SIS, single-conductor, Class B, stranded copper, rated 600 volts for control, instrumentation, and power/current circuits.
- B. Transducer Output/Analog Circuits: Shielded cable rated 600 volts.
- C. Enclosed in top and vertical steel wiring troughs, and front-to-rear in nonmetallic wiring troughs.
- D. Conductor Lugs: Preinsulated, self-locking, spade type, with reinforced sleeves.
- E. Identification: Individually, with permanent wire markers at each end.
- F. Splices: Not permitted in switchboard wiring.

2.10 TERMINAL BLOCKS

- A. Enclosed in steel wiring troughs.
- B. Rated 600 volts, 30 amperes minimum, one-piece barrier type with strap screws.
- C. Shorting type for current transformer leads.
- D. Provide terminal blocks for:
 - 1. Conductors connecting to circuits external to switchboard.
 - 2. Internal circuits crossing shipping splits.
 - 3. Equipment parts requiring replacement and maintenance.
- E. Spare Terminals: Not less than 20 percent.
- F. Group terminal blocks for external circuit wiring leads.

- G. Maintain 6-inch minimum space between columns of terminal blocks.
- H. Identification: Permanent, for each terminal and columns of terminals blocks.

2.11 INSTRUMENT TRANSFORMERS AND METERS

- A. Provide as specified in Section 26 09 13, Instrument Transformers, Meters, Switches and Accessories.

2.12 SURGE PROTECTION DEVICES

- A. Provide surge protection for each bus per 26 43 13, Surge Protective Devices.

2.13 KEY INTERLOCK

- A. Mechanical lock cylinder within main and tie breaker compartments.
- B. Key and Lock Cylinder Type: Kirk.
- C. Keys to be captive when breakers are closed.
- D. Two keys available for each group of three locks.

2.14 EQUIPMENT IDENTIFICATION

- A. Master Nameplate:
 - 1. Deep-etched aluminum with manufacturer's name and model number.
 - 2. Riveted to main vertical section.
- B. Section Identification:
 - 1. Stamped metallic, riveted to each vertical section.
 - 2. Serial number, bus rating, and section reference number.
 - 3. Size: Manufacturer's standard.
- C. Nameplate:
 - 1. Engraved, phenolic for each circuit breaker cubicle and door-mounted device.
 - 2. Black with white block type characters.
 - 3. Character Height: 3/16 inch.
 - 4. Size: Manufacturer's standard.
 - 5. Inscriptions: As shown on one-line diagram.
 - 6. Blank plates for future spaces.
 - 7. Attachment Screws: Self-tapping.
- D. Cubicle Labels:
 - 1. Nonmetallic, applied inside each cubicle compartment.
 - 2. Device serial number, rating, and description.
- E. Metering Instruments: Meter type identified on meter face below pointer or dial.
- F. Control Switches: Deep-etched, aluminum escutcheon plate.
- G. Relays and Devices:
 - 1. Stamped metallic, riveted to instrument case.
 - 2. Manufacturer's name, model number, relay type, and rating data.
- H. Switchboard Signs:
 - 1. Two signs each on front and back of switchboard.
 - 2. Size: Manufacturer's standard.
 - 3. Engraved, phenolic.
 - 4. Color: Red with white.
 - 5. Inscription: DANGER/HIGH VOLTAGE/KEEP OUT.
 - 6. Characters: Gothic type, 1 inch high.
 - 7. Attachment: Four rivets each sign.

2.15 FACTORY TESTING

- A. Performance tests in accordance with UL 891 and production test in accordance with NEMA PB-2.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions and recommendations.
- B. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.
- C. Install equipment plumb and in longitudinal alignment with pad or wall.
- D. Coordinate terminal connections with installation of secondary feeders.

3.2 POWER MONITORS

- A. Power monitors shall be tested for verification of correct amps, volts, hertz, power factor, and harmonics by comparison of the signal into the plant's power monitoring system with a high accuracy hand held meter.

3.3 FIELD TESTS

- A. Switchboard assembly shall be tested in accordance with Section 26 08 00, Commissioning of Electrical Systems.

3.4 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative for the following services at site or classroom as designated by Owner for minimum person-days listed below, travel time excluded:
 - 1. 1 person-days for installation inspection and prestart up classroom training.
- B. Furnish startup services and training of Owner's personnel at such times as requested by Owner.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: This section specifies low-voltage dry-type transformers.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Institute of Electrical and Electronics Engineers (IEEE): C57.96, Guide for Loading Dry Type Transformers.
 2. National Electrical Contractor's Association (NECA): 409, Recommended Practice for Installing and Maintaining Dry-Type Transformers.
 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ST 20, Dry-Type Transformers for General Applications.
 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 5. Underwriters Laboratories Inc. (UL):
 - a. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - b. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - c. 1561, Standard for Dry-Type, General Purpose, and Power Transformers.

1.3 SUBMITTALS

- A. Action Submittal Items for this Section:
1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from Section requirements.
 2. Operation and maintenance items as specified in Section 01 78 23 – Operation and Maintenance Manuals.
 3. Descriptive information.
 4. Dimensions and weight.
 5. Transformer nameplate data.
 6. Schematic and connection diagrams.
 7. Seismic anchorage and bracing drawings and cut sheets.
- B. Informational Submittals:
1. Seismic anchorage and bracing calculations.
 2. Test Report: Sound test certification for dry type power transformers (0 to 600 volt, primary).

PART 2 - PRODUCTS

2.1 GENERAL

- A. UL 1561, NEMA ST 20, unless otherwise indicated.
- B. Dry-type, self-cooled, two-winding, with copper windings.
- C. Units larger than 5 kVA suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- D. Efficiency: Transformers Rated 15-kVA and Larger:
1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.

- 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL
- E. Maximum Sound Level per NEMA ST 20:
 - 1. 40 decibels for 0 kVA to 9 kVA.
 - 2. 45 decibels for 10 kVA to 50 kVA.
 - 3. 50 decibels for 51 kVA to 150 kVA.
 - 4. 55 decibels for 151 kVA to 300 kVA.
 - 5. 60 decibels for 301 kVA to 500 kVA.
- F. Overload capability: Short-term overload per IEEE C57.96.
- G. Wall Bracket: For single-phase units, 15 kVA to 37 1/2 kVA, and for three-phase units, 15 kVA to 30 kVA.
- H. Vibration Isolators:
 - 1. Rated for transformer's weight.
 - 2. Isolation Efficiency: 99 percent, at fundamental frequency of sound emitted by transformer.
 - 3. Less Than 30 kVA: Isolate entire unit from structure with external vibration isolators.
 - 4. 30 kVA and Above: Isolate core and coil assembly from transformer enclosure with integral vibration isolator.
- I. Manufacturers:
 - 1. Eaton.
 - 2. General Electric Co.
 - 3. Square D Co.

2.2 GENERAL PURPOSE TRANSFORMER

- A. Insulation Class and Temperature Rise: Manufacturer's standard.
- B. Core and Coil:
 - 1. Encapsulated for single-phase units 1/2 kVA to 25 kVA and for three-phase units 3 kVA to 15 kVA.
 - 2. Thermosetting varnish impregnated for single-phase units 37.5 kVA and above, and for three-phase units 30 kVA and above.
- C. Enclosure:
 - 1. Single-Phase, 3 kVA to 25 kVA: NEMA 250, Type 3R, nonventilated.
 - 2. Single-Phase, 37 1/2 kVA and Above: NEMA 250, Type 2, ventilated.
 - 3. Three-Phase, 3 kVA to 15 kVA: NEMA 250, Type 3R, nonventilated.
 - 4. Three-Phase, 30 kVA and Above: NEMA 250, Type 2, ventilated.
 - 5. Outdoor Locations: NEMA 250, Type 3R.
 - 6. Corrosive Locations: NEMA 250, Type 3R stainless steel.
- D. Voltage Taps:
 - 1. Single-Phase, 3 kVA to 10 kVA: Two 5 percent, full capacity, normal voltage rating.
 - 2. Single-Phase, 15 kVA and Above: Four 2 1/2 percent, full capacity; two above and two below normal voltage rating.
 - 3. Three-Phase, 3 kVA to 15 kVA: Two 5 percent, full capacity, normal voltage rating.
 - 4. Three-Phase, 30 kVA and Above: Four 2 1/2 percent, full capacity; two above and two below normal voltage rating.
- E. Impedance: 4.5 percent minimum on units 75 kVA and larger.

2.3 NAMEPLATES

- A. Refer to Section 26 05 00, General Requirements for Electrical Work.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NECA and manufacturer's instructions.
- B. Load external vibration isolator such that no direct transformer unit metal is in direct contact with mounting surface.
- C. Provide moisture-proof, flexible conduit for electrical connections.
- D. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.
- E. Provide wall brackets for single-phase units, 15 kVA to 167 1/2 kVA, and three-phase units, 15 kVA to 112 kVA.

END OF SECTION

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SECTION 26 24 16
LOW-VOLTAGE PANELBOARDS

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):
 - a. C62.1, Surge Arresters for Alternating Current Power Circuits.
 - b. C62.11, Standards for Metal-Oxide Surge Arrestors for AC Power Circuits.
 2. National Electrical Contractors Association (NECA): 407, Recommended Practice for Installing and Maintaining Panelboards.
 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. 289, Application Guide for Ground Fault Circuit Interrupters.
 - c. AB 1, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - d. KS 1, Enclosed Switches.
 - e. LA 1, Surge Arrestors.
 - f. PB 1, Panelboards.
 - g. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 5. Underwriters Laboratories Inc. (UL):
 - a. 67, Standard for Panelboards.
 - b. 98, Standard for Enclosed and Dead-Front Switches.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 870, Wireways, Auxiliary Gutters and Associated Fittings.
 - g. 943, Standard for Ground-Fault Circuit-Interrupters.

1.2 SUBMITTALS

- A. Action Submittals:
1. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
 2. Manufacturer's shop drawings including dimensioned plan, section, and elevation for each panelboard type, enclosure, and general arrangement.
 3. Tabulation of features for each panelboard to include the following:
 - a. Protective devices with factory settings.
 - b. Provisions for future protective devices.
 - c. Space for future protective devices.
 - d. Voltage, frequency, and phase ratings.
 - e. Enclosure type.
 - f. Bus and terminal bar configurations and current ratings.
 - g. Provisions for circuit terminations with wire range.
 - h. Short circuit current rating of assembled panelboard at system voltage.
 - i. Features, characteristics, ratings, and factory settings of auxiliary components.
 - j. Seismic anchorage and bracing drawings and cut sheets.
- B. Informational Submittals:

1. Manufacturer's recommended installation instructions.

1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled as defined in NEC Article 100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 1. Eaton/Cutler-Hammer.
 2. General Electric Co.
 3. Square D Co.
 4. Or equivalent.
- B. Panelboards shall be of the same manufacturer as equipment furnished for low voltage switchboards and low voltage motor control for standardization.

2.2 GENERAL

- A. Provide low voltage panelboards for application at 600V or less in accordance with this Section.
- B. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.
- C. Wire Terminations:
 1. Panelboard assemblies, including protective devices, shall be suitable for use with 75 degrees C or greater wire insulation systems at NEC 75 degrees C conductor ampacity.
 2. In accordance with UL 486E.
- D. Load Current Ratings:
 1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.
 2. Where indicated "continuous", "100 percent", etc., selected components and protective devices shall be rated for continuous load current at value shown.
- E. Short Circuit Current Rating (SCCR): Integrated equipment short circuit rating for each panelboard assembly shall be no less than the following:
 1. Minimum SCCR at 208Y/120 or 120/240 volts shall be 18,000 amperes rms symmetrical.
 2. Minimum SCCR at 480Y/277 volts shall be 50,000 amperes rms symmetrical.
- F. Overcurrent Protective Devices:
 1. In accordance with NEMA AB 1, NEMA KS 1, UL 98, and UL 489.
 2. Protective devices shall be adapted to panelboard installation.
 - a. Capable of device replacement without disturbing adjacent devices and without removing main bus.
 - b. Spaces: Cover openings with easily removable cover.
 3. Devices shall be fully rated; series-connected ratings unacceptable.
- G. Circuit Breakers:
 1. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
 2. Noninterchangeable: In accordance with NEC.
 3. Bus Connection: Bolt-on circuit breakers in 480Y/277-volt, and plug-in circuit breakers in 208Y/120 and 240/120-volt branch circuit panelboards.
 4. Trip Mechanism:
 - a. Individual permanent thermal and magnetic trip elements in each pole.
 - b. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.

- c. Two and three pole, common trip.
 - d. Automatically opens all poles when overcurrent occurs on one pole.
 - e. Test button on cover.
 - f. Calibrated for 40 degrees C ambient, unless shown otherwise.
5. Unacceptable Substitution:
 - a. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
 - b. Do not use tandem or dual circuit breakers in normal single-pole spaces.
 6. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
 - a. Ground fault sensor shall be rated same as circuit breaker.
 - b. Push-to-test button.
 - c. Reset button.
 7. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL listed for equipment ground fault protection).
- H. Enclosures:
1. Provide as specified in Section 26 05 04, Basic Electrical Materials and Methods.
 2. Material: Type 1, shall be code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
 3. Finish: Rust inhibitor prime followed by manufacturer's standard gray baked enamel or lacquer.
- I. Bus:
1. Material: Tin-plated copper full sized throughout length.
 2. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.
- J. Feeder Lugs: Main, feed-through, and neutral shall be replaceable, bolted mechanical or crimp compression type.
- K. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors, and bonded to box.
1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
 2. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.
- L. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.
1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
 2. Provide individual termination points for all other neutral conductors.
- M. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.
- N. Special Features:
1. Service Equipment Approval: Listed for use as service equipment for panelboards having service disconnecting means.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Protective Device Locking: Furnish provisions for handle padlocking for main and subfeed devices; also provide for branch devices where indicated.
- B. NEMA 250 Type 1 Branch Panelboard Enclosure:
 1. Front trim shall be secured to box with concealed trim clamps.

2. Surface-mount panelboard front trim shall have same dimensions as box.
3. Flush panelboards front trims shall overlap box nominal 3/4 inch on all sides.
4. Door in panelboard front trim, with concealed hinges, shall provide access to protective device operating handles.
5. Doors over 30 inches in height shall have multi-point latching.
6. Door lock shall be secure with flush catch and tumbler lock; all panelboards keyed alike, with two milled keys each lock.
7. Circuit Directory: Metal frame with transparent plastic face and enclosed card, mounted inside each panel door.
8. Hinged Front Cover (Door in Door): Entire front trim hinged to surface box with standard door within hinged trim cover.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install in accordance with NECA 407, NEMA PB 1.1 and manufacturers' written installation instructions.
- B. Install securely, plumb, in-line and square with walls.
- C. Install top of cabinet trim 78 inches above floor, unless otherwise shown. Install cabinet so tops of protective device operating handles are no more than 78 inches above the floor.
- D. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.
- E. Install filler plates in unused spaces.
- F. Wiring in Panel Gutters: Train conductors neatly in groups; bundle, and wrap with nylon wire ties.

3.2 BRANCH CIRCUIT PANELBOARD

- A. Mount flush panels uniformly flush with wall finish.
- B. Provide typewritten circuit directory for each panelboard.

END OF SECTION

SECTION 26 24 19
LOW-VOLTAGE MOTOR CONTROL

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American national Standard Institute (ANSI):
 - a. C2, National Electrical Safety Code (NEC)
 - b. C57.12.28, Switchgear and Transformers – Pad-Mounted Equipment – Enclosure Integrity.
 - c. Z55, Gray Finishes for Industrial Apparatus and Equipment.
 2. National Electrical Manufacturers Association (NEMA)
 - a. AB1, Molded Case Circuit Breakers.
 - b. ICS 1, General Standards for Industrial Control and Systems.
 - c. ICS 2, Standards for Industrial Control Devices, Controllers, and Assemblies.
 - d. ICS 2.3, Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers.
 - e. ICS 2-322, AC General Purpose Motor Control Centers
 - f. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - g. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 3. National Fire Protection Association (NFPA 70): National Electrical Code (NEC).
 4. Underwriters Laboratories, Inc. (UL):
 - a. 98, Standard for Safety Enclosed and Dead-Front Switches.
 - b. 489, Standard for Safety Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - c. 845, Standard for Safety Motor Control Centers.
 - d. Uniform Building Code (UBC):

1.2 DESIGN REQUIREMENTS

- A. Provide MCC based upon applicable NEMA and UL standards and in accordance with the detailed contract specifications and drawings.
- B. Ethernet/IP Protocol: All Ethernet connected terminal equipment specified herein shall be provided with a native Ethernet/IP port. Separate protocol converters and gateways used to convert from other protocols will not be accepted.
- C. Motor Controller Units: Unit elements shall be of the same manufacturer as the motor control centers. Variance may only be considered to meet Ethernet/IP protocol requirements.
- D. The contractor shall confirm motor full-load amperage ratings and provide those to the MCC manufacturer to ensure proper sizing of the motor branch circuit and overload protection.

1.3 SUBMITTALS

- A. Shop Drawings:
1. Itemized bill of material
 2. Nameplate information
 3. Descriptive information
 4. Dimensional drawings
 5. Conduit entrance locations
 6. One-line diagrams
 7. Schematic (elementary) diagrams for each starter unit and an interconnection diagram for the entire motor control center including all field devices.
 8. Outline diagrams

9. Bus data
 10. Data sheets and publications on all major components
 11. Protective devices, time current curves for all protection devices, and time-current curve diagrams showing coordination between the main circuit breakers and feeder breakers.
 12. Anchoring instructions and details.
 13. Typed tabulation (provide in O&M Manual):
 - a. Motor name; tag (equipment) numbers as shown on Drawings.
 - b. Motor horsepower.
 - c. Nameplate full load current.
 - d. Measured load current and voltage.
 - e. Overload settings.
 - f. Protective device trip settings.
 14. Attach above typed, tabulated data to a copy of starter manufacturer's overload heater selection tables for the starters provided.
 15. Control diagrams.
- B. Quality Control Submittals:
1. Manufacturer's installation instructions
 2. Operation and Maintenance Manual
 3. Factory test reports
- C. Letter of coordination from the MCC manufacturer stating that the Surge Protective Devices selected for the MCC has been coordinated with and will not adversely affect the active harmonic filter.

1.4 UL COMPLIANCE

- A. Products manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL Listing Mark.

1.5 PACKING AND SHIPPING

- A. Shipping splits: Established by Contractor to facilitate ingress of equipment to final installation location within the building.

PART 2 - PRODUCTS

2.1 CANDIDATE MANUFACTURERS/PRODUCTS

- A. Candidate manufacturers and models of Low Voltage Motor Control Centers are listed below. To conform with specified requirements, the manufacturer's standard product may require modification.
1. Eaton Freedom 2100
 2. Allen Bradley Centerline 2100
 3. Approved equivalent.
- B. Low voltage motor control manufacturer shall be the same manufacturer as low voltage switchboard and low voltage panelboards for standardization.

2.2 GENERAL:

- A. In accordance with NEMA ICS 2 and UL 845.
- B. Voltage Rating: 600 volts, 60 hertz, 3-phase, 3-wire.
- C. Short Circuit Rating: 65,000 amperes rms symmetrical for entire motor control center as a complete assembly.
- D. All controllers, main and branch circuit breakers, wire connections, and other devices to be front mounted and accessible unless otherwise noted.

- E. NEMA ICS 2, Section 322.08
 - 1. Class: I.
 - 2. Type: B.
- F. Adjust as necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.
- G. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- H. Operating Conditions:
 - 1. Ambient Temperature: Maximum 40 degrees C.
 - 2. Equipment to be fully rated without any derating for operating conditions.
 - 3. Enclosures: In accordance with NEMA 250 and ANSI C57.12.28.

2.3 ENCLOSURE

- A. Type: NEMA 250 Type 1, gasketed.
- B. Vertical Section Dimensions: 90 inches high, 20 inches (or 30 inches as required) wide, 20 inches deep.
- C. Construction:
 - 1. Sheet steel reinforced with channel or angle irons.
 - 2. Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.
 - 3. Removable top cover plates.
 - 4. Removable plates on end panels for future bus extension.
- D. Section Mounting: Removable formed-steel channel sills and lifting angles to meet specified seismic requirements.
- E. Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.
- F. Vertical Wiring Compartments: Full height, isolated from unit starters with separate hinged door.
- G. Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.
- H. Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.
- I. Door Interlocking: Interlock starter and feeder doors mechanically so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access at any time.
- J. External disconnect handles, padlockable in OFF position.
- K. Cable Entrance: Main leads enter from the bottom; control and feeder circuits enter from top and bottom.
- L. Hardware for mounting future starter and feeder tap units shall be provided at compartments specified as "FUTURE" and "SPACE."
- M. Anchor Bolts: Galvanized, sized by equipment manufacturer, 1/2-inch minimum diameter.
- N. Equipment Finish:
 - 1. Electroplating process applied over a rust-inhibiting phosphate base coating.
 - 2. Exterior Color: ANSI Z55.1, No. 61, light gray.

2.4 BUS:

- A. Horizontal Power Bus:
 - 1. Three-phase tin-plated, copper, entire width of control center, rated as indicated.
 - 2. Construct to allow future extension of additional sections.
 - 3. Pressure type solderless lugs for each incoming line cable.

- 4. Isolated from top horizontal wireway.
- B. Vertical Power Bus:
 - 1. Three-phase tin plated copper, full height of section, rated 300 amperes (min).
 - 2. Sandwich type bus insulation providing dead front construction with starter units removed except for bus stab openings.
 - 3. Insulated and isolated barrier complete with shutters.
- C. Neutral Bus: 50 percent of main horizontal bus rating unless otherwise shown on one-line diagram.
- D. Ground Bus: Copper, 33 percent minimum of phase bus ampacity, entire width of control center.
- E. Bus Bracing: 65,000 amperes rms symmetrical.

2.5 WIRING:

- A. Internal wiring and provisions of or external terminations and interfacing shall be provided in strict accordance with the Control Wiring Diagrams.
- B. Provide wiring and terminals in MCC buckets in accordance with the wiring diagrams provided with the contract drawings.
- C. All starter units shall have terminal blocks for control wiring. Terminal blocks shall be provided for power wiring for starters size 2 and smaller. Motor control centers shall be provided with all necessary interconnecting wiring and interlocking. Provide a drawing pocket in each unit.
- D. Power Wire: Power wire shall be copper 90 degrees C "MTW" insulated, sized to suit load; minimum power wire size shall be No. 12 AWG copper stranded.
- E. Control Wire: Control wire shall be No. 14 AWG stranded copper wire, rated 90 degrees C and UL listed for panel wiring.
- F. Terminals: Provide crimp type terminals made from electrolytic copper, tin-plated. Provide cable termination connectors to match cable size and quantities as indicated on the drawings.
- G. Conductor Markers:
 - 1. All internal wiring in MCC buckets shall be numbered with a basic wire numbering scheme. Wires which terminate on a terminal shall have the terminal number. Wires that leave the MCC shall be labeled in accordance with Sections 26 05 00 and 26 24 19.
 - 2. Markers used for identification shall meet the requirements of Section 26 05 00.

2.6 MAIN PROTECTIVE DEVICE AND FEEDER UNITS:

- A. Molded Case Circuit Breaker:
 - 1. In accordance with NEMA AB1 and UL 489.
 - 2. Thermal magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
 - 3. The tripped position shall be clearly indicated by breaker handle maintaining a position between "ON" and "OFF." All poles shall open, close, and trip simultaneously.
 - 4. Suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
- B. Main protective device shall be 100% rated, with frame size, solid state trip unit, rating plug, and the following fully adjustable (dynamic) trip functions: Long Time delay, Short Time Pick-up, Short Time delay, Instantaneous, Ground Fault Pick-up, and Ground Fault delay.
- C. Feeder protective devices 250A and greater shall include solid state trip unit, rating plug, and fully coordinate with the main breaker.
- D. Arc Flash: Provide arc flash reduction maintenance system on all main breakers and feeder breakers rated 400A or greater.
 - 1. System shall not compromise breaker phase protection when enabled.
 - 2. Clearing time of 0.04 seconds, adjustable 2.5X to 10X of the sensor value.

3. Enabled via door mounted lockable lockout/tagout selector switch with confirmation via a blue LED indication lamp.
4. All indicating lamps shall have an integrated lamp-test function or a common lamp test switch for all lamps.
5. Provide associated control power transformer as required.

2.7 MOTOR CONTROLLER UNIT:

- A. NEMA ICS 2, Class A. Units shall provide integral phase-loss and phase-unbalance protection.
- B. Provide indicated individual components and control devices including pushbuttons, selector switches, indicating lights, control relays, time delay relays, and elapsed time meters as specified in 26 05 04 – Basic Electrical Materials and Methods.
- C. Construction:
 1. Draw-out combination type with stab connections for starters NEMA ICS, Size 4 and smaller.
 2. Bolt-on combination type with cable connection to riser for starters NEMA ICS, Size 5 and larger.
 3. Readily interchangeable with starters of similar size.
 4. Pull-apart unit control wiring terminal boards on all units.
- D. Electromechanical Starters:
 1. NEMA ICS 2, Section 322.08 standard rating, except none smaller than NEMA ICS, size 1.
 2. Rating: HP rated at 600 volts, UL labeled for 65,000 amperes with overload protection.
 3. Three-phase, non-reversing.
 4. Disconnect type: Motor circuit protector (MCP) with size based on the specific motor supplied. Trip setting shall be adjustable from 700 to 1300 percent of the motor full load amperes from the front of the breaker.
 5. Combination Full Voltage Magnetic Starter:
 - a. Control: As shown.
 6. Padlockable operating handle when de-energized.
 7. Unit door interlocked to prevent opening when disconnect is in CLOSED position.
 8. Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.
 9. Minimum Dimensions: 12 inches high by full section width, less vertical wireway.
- E. Disconnecting Device:
 1. As indicated.
 2. Padlockable in OPEN position.
- F. Overload Protection:
 1. All motor starters shall include fully programmable electronic overload relays with I/O as shown in the Drawings.
 2. Overload relays shall monitor all three phases individually for current and voltage and provide thermal overload, power measurements, ground fault detection.
 3. Provide communications capability via native Ethernet/IP data port.
 4. Provide CT's as required for motor load.
 5. User interface shall be accessible without opening the cubicle door.
 6. Protective functions:
 - a. Thermal overload
 - b. Jam
 - c. Over/under current
 - d. Current unbalance
 - e. Phase loss
 - f. Phase reversal
 - g. Over/under voltage
 - h. Voltage unbalance

- i. Over/under power (kW)
- j. Power factor
- 7. Monitoring functions:
 - a. Phase currents
 - b. Current unbalance
 - c. Ground fault current
 - d. Over/under current trip
 - e. Thermal capacity
 - f. Phase voltage
 - g. Voltage unbalance
 - h. Over/under voltage trip
 - i. Over/under power trip
 - j. Real power (kW)
 - k. Power factor
 - l. Frequency
 - m. Motor starts count
 - n. Motor starts time
 - o. Fault history
- 8. Control functions:
 - a. Local with hardwire
 - b. Network/remote
 - c. Programmable alarms
 - d. Programmable trips
 - e. Normally open dry contact rated 1 amp (min) at 120 VAC for remote alarming.
- 9. Provide cables and necessary software to access data via portable computer.
- G. Control Transformer:
 - 1. Two winding, 120-volt secondary, primary voltage to suit.
 - 2. Two current-limiting fuses for primary circuit.
 - 3. One fuse in secondary circuit.
 - 4. All fuses shall be provided with blown fuse indicators.
 - 5. Mount within starter unit.
 - 6. Sized for load shown.

2.8 MISCELLANEOUS:

- A. Nameplates: In accordance with Section 26 05 00, General Requirements for Electrical Work.
 - 1. Each motor control center compartment shall have a nameplate designating the equipment and its identifying number and size or rating. Data shall be as shown on one-line diagrams.
 - 2. Provide one large nameplate for each motor control center identifying the motor control center name and number with 1" lettering.
 - 3. Equipment titles and numbers shall be completely spelled out on nameplates or as shown on the drawings.
 - 4. Nameplates shall also be provided for identifying all relays and devices that are located inside the panels and shall be of the sandwich phenolic described above or approved equal.
 - 5. Nameplates shall be mounted in a manner or location such that other equipment or devices do not block them and are easily viewed.
- B. Power Monitor and Display (PMD):
 - 1. PMD shall be in accordance with Section 26 09 13, Instrument Transformers and Meters.
- C. Ethernet/IP Communications:
 - 1. Each electronic overload relay and power monitor (PMD) in the MCC shall be supplied with a means to communicate via Ethernet/IP protocol and shall be networked via Ethernet switch. The MCC shall include an industrial Ethernet switch and Ethernet wiring incorporated into its design for interfacing the overload relays and meter to the facility control network.

2. Power supplies shall have a 500 ms load ride through at full load.
 3. Ethernet cabling shall be incorporated throughout the entire lineup. All copper Ethernet cable shall be 600 V UL Shielded Category 6A.
 4. Metering and overload relays shall be connected in a star topology. Switch-to-switch connections shall be connected in a linear topology.
 5. Ethernet switch: Rockwell Automation Stratix 5700 Industrial Managed Ethernet Switch, or equivalent.
- D. Uninterruptible Power Supply (UPS):
1. A separately mounted 120VAC UPS furnished and installed under Section 40 98 00 – Control Panels and Enclosures will provide power to the MCC mounted Ethernet switch and PMD.
- E. Active Harmonic Filters:
1. When shown on the Drawings, provide properly sized feeder overcurrent protection and current transformer space for Active Harmonic Filters specified in Section 26 35 26. Provide current transformer shorting block within the MCC to facilitate current transformer wiring.
- F. Surge Protective Device (SPD):
1. Provide metal oxide varistor (MOV) surge protective device integral within each motor control center per Section 26 43 13, Surge Protective Devices.
 2. Provide protective device as disconnecting means and short circuit protection per manufacturer's recommendation.
 3. SPD type selection shall be coordinated with active harmonic filter installation to prevent mis-operation due to SPD capacitors.
 4. Mount in dedicated bucket.
- G. Spare Parts:
1. In addition to spare parts mentioned elsewhere in this section, the Contractor shall supply the following spare parts for use by the Owner. Spare parts shall be provided in a NEMA 1 storage box with hinged door for wall mounting as directed by Owner:
 - a. 100% spare LED lamp type used for indicating lights.
 - b. One spare control, time delay phase fail, etc. relay of each type used. or 20% whichever is the greater number.
 - c. One spare lens of each color used for indicating lights.
 - d. Two spare fuses for each fuse provided under 10 amps and one spare fuse for each fuse provided over 10 amps.
 - e. One spare overload relay for each type and size provided.
 - f. Spare parts shall be provided with the motor control equipment when shipped to the site.

PART 3 - EXECUTION

3.1 GENERAL

- A. It is the Contractors responsibility to verify that the motor starters, protection equipment, and other components, etc. provided are suitable (correct phase, voltage, starter type, correct breakers, and overload relays) for the motors and equipment loads being served.
- B. Operator interface devices such as metering and devices with control and displays shall be installed between 5' and 5'-8" above finished floor. Operator interface devices on full height sections shall be installed between 4'-6" and 6' above finished floor.

3.2 INSTALLATION

- A. Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.

- B. Secure equipment to mounting pads with anchor bolts of sufficient size and number for specified seismic conditions.
- C. Install equipment plumb and in longitudinal alignment with pad or wall.
- D. Coordinate terminal connections with installation of secondary feeders.
- E. Grout mounting channels into floor or mounting pads.
- F. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.
- G. Cables larger than No. 6 AWG which hang from their vertical connections shall be supported within 2 feet of the connection.

3.3 CIRCUIT BREAKERS

- A. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.
- B. Adjust to approximately 11 times motor rated current.
- C. Determine motor rated current from motor nameplate following installation.

3.4 OVERLOAD RELAYS

- A. The setting of the overload relays shall be by the Contractor and adjusted based on the actual full load amperes of the motor connected to the starter.
- B. Verify overload relays operate in accordance manufacturer's instructions.

3.5 POWER MONITORS

- A. Power monitors shall be tested for verification of correct amps, volts, hertz, power factor, and harmonics by comparison of the signal into the plant's power monitoring system with a high accuracy handheld meter.

3.6 MOTOR DATA

- A. Provide typed, self-adhesive label attached inside each motor control starter enclosure door displaying the following information:
 - 1. Motor served by tag number and equipment name.
 - 2. Nameplate horsepower.
 - 3. Motor code letter.
 - 4. Full load amperes.
 - 5. Service factor.
 - 6. Overload settings.

3.7 FIELD TESTS

- A. Motor control centers shall be tested in accordance with Section 26 08 00, Commissioning of Electrical Systems.

3.8 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative in accordance with Section 01 75 00 - Checkout and Start-Up Procedures, for the following services at site or classroom as designated by Owner for minimum person-days listed below, travel time excluded:
 - 1. 2 person-days for installation inspection and pre-startup classroom training.
- B. Furnish startup services and training of Owner's personnel at such times as requested by Owner to accommodate the shift schedules of Owner's operation and maintenance staff.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM): A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 2. Federal Specifications (FS):
 - a. W-C-596G, General Specification for Connector, Electrical, Power.
 - b. W-S-896F, Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
 3. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
 - a. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
 - b. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
 4. National Electrical Contractors Association (NECA): 1, Standard Practice of Good Workmanship in Electrical Contracting.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. FB 11, Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
 - c. WD 1, General Color Requirements for Wiring Devices.
 - d. WD 6, Wiring Devices – Dimensional Specifications.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. Underwriters Laboratories Inc. (UL):
 - a. 498, Standard for Safety for Attachment Plugs and Receptacles.
 - b. 508, Standard for Safety for Industrial Control Equipment.
 - c. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
 - d. 1010, Standard for Safety for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - e. 1436, Standard for Safety for Outlet Circuit Testers and Similar Indicating Devices.
 - f. 1449, Standard for Safety for Surge Protective Devices (SPD).

1.2 SUBMITTALS

- A. Action Submittals: Manufacturer's product data for wiring devices.

PART 2 - PRODUCTS

2.1 SWITCHES

- A. Switch, General Purpose:
1. NEMA WD 1 and FS W-S-896F.
 2. Totally enclosed, ac type, with quiet tumbler switch and screw terminal.
 3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contact.
 4. Capable of controlling 100 percent LED lamp loads.
 5. Rating: 20 amps, 120/277 volts.
 6. Automatic grounding clip and integral grounding terminal on mounting strap.
 7. Special Features: Provide the following features in comparable devices where indicated:
 - a. Three-way and four-way.
 8. Manufacturers and Products, Industrial Grade:

- a. Cooper Arrow Hart; AH1220 Series.
- b. Bryant; 4901 Series.
- c. Hubbell; 1221 Series.
- d. Leviton; 1221 Series.

2.2 SWITCH, MOTOR RATED:

- A. UL 508 listed.
- B. Rated for fractional horsepower and integral horsepower to maximum of 10HP at 600V.
- C. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.
- D. Types:
 - 1. Horsepower rated, for ON/OFF control.
 - 2. Horsepower rated, for ON/OFF control and thermal overload protection.
 - a. Switch to clearly indicate ON, OFF, and TRIPPED position.
- E. Voltage and current ratings and number of poles as required for the connected motor.

2.3 RECEPTACLES

- A. Receptacle, General Purpose:
 - 1. NEMA WD 1 and FS W-C-596G.
 - 2. Duplex, two-pole, three-wire grounding type with screw type wire terminals.
 - 3. Impact resistant nylon cover and body, with finger grooves in face, unless otherwise indicated.
 - 4. One-piece mounting strap with integral ground contact (rivetless construction).
 - 5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
 - 6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, unless otherwise indicated.
 - 7. Size: For 2-inch by 4-inch outlet box.
 - 8. Industrial Grade Manufacturers and Products:
 - a. Cooper Arrow Hart; 5362 Series.
 - b. Hubbell Bryant; HBL5362 Series.
 - c. Leviton; 5362 Series.
- B. Receptacle, Ground Fault Circuit Interrupter:
 - 1. Meet requirements of general-purpose receptacle.
 - 2. Listed Class A to UL 943, tripping at 5 mA.
 - 3. Rectangular smooth face with push-to-test and reset buttons.
 - 4. Listed weather-resistant per NEC 406.8.
 - 5. Feed-through Capability: 20 amps.
 - 6. Manufacturers and Products:
 - a. Hubbell Bryant; GFTR20 Series.
 - b. Cooper Arrow Hart; WRVGF20 Series.
 - c. Leviton; 7899 Series.
- C. Receptacle, Corrosion-Resistant:
 - 1. Meet requirements of general-purpose receptacle.
 - 2. Nickel coated metal parts.
 - 3. Manufacturers and Products:
 - a. Hubbell Bryant; HBL53CM62 Series.
 - b. Leviton; 53CM-62 Series.
 - c. Cooper Arrow Hart; 5362CR Series.
- D. Receptacle, Special-Purpose:
 - 1. General:
 - a. Rating and number of poles as indicated or required for anticipated purpose.
 - b. Provide matching plug with cord-grip features for each special-purpose receptacle.

2. Standard Duty Receptacles and Plugs:
 - a. Rating: Voltage and ampere ratings as shown.
 - b. Provide handles, adapter plates, metal adapters, cord grips, dead front safety shutter, closed lid configuration and accessories as required for the installation.
 - c. Provide auxiliary contacts for additional motor controls where applicable.
 - d. Manufacturers:
 - 1) Meltric; DR series, or equivalent.
3. Multipin Compact Control Receptacles and Plugs;
 - a. Control plugs and receptacles for influent pump motor moisture and temperature controls,
 - b. Rating:
 - 1) Voltage rating as shown,
 - 2) 5-amp current interrupting. Suitable for 4-20mA low current applications.
 - c. Manufacturers:
 - 1) Meltric; PN12c, or equivalent.

2.4 HAZARDOUS (CLASSIFIED) LOCATION DEVICES

- A. Wiring devices for hazardous (classified) locations shall comply with NEMA FB 11 and UL 1010.
- B. Provide enclosures as specified in 26 05 04 - Basic Electrical Materials and Methods.
- C. Switches:
 1. Manufacturer and Products:
 - a. Crouse-Hinds EDS Series
 - b. Killark XS Series
 - c. Or equivalent
- D. Manually Operated Starters, Fractional Horsepower:
 1. Manufacturer and Products:
 - a. Crouse Hinds EDS Series
 - b. Killark XSD Series
 - c. Or equivalent
- E. Manually Operated Starters, Integral Horsepower:
 1. Manufacturer and Products:
 - a. Killark XMSW Series
 - b. Crouse-Hinds EMN Series
 - c. Or equivalent
- F. Receptacles, General:
 1. Contain integral switch which must be closed to energize circuit.
 2. Design shall permit only an approved plug to be energized.
 - a. Actuation of switch shall require plug be inserted and rotated approximately 45 degrees.
 - b. Plug shall lock into this position preventing unintended disengagement.
 - c. To remove, plug shall be turned opposite direction as engagement and pulled straight out.
- G. General Purpose Receptacle, Explosion Proof, 125 Volts, 20 Amps:
 1. Dead front, interlocked, circuit breaking.
 2. Receptacle Cover: Spring loaded closes when plug is removed.
 3. Enclosure: Corrosion-resistant, aluminum alloy with less than 0.4 percent copper.
 4. Finish: Electrostatically applied and baked powder epoxy/polyester.
 5. External Hardware: Type 316 stainless steel.
 6. Switch Chamber: Factory sealed to contain switch's arcing components
 7. Hazardous Area Ratings: Suitable for Class I, Division 2, NEMA 7BCD, 9FG.
 8. Provide matching plug with each receptacle.

9. Manufacturers and Products:
 - a. Cooper Crouse-Hinds; Ark Guard 2, Series ENR.
 - b. EGS/Appleton Electric; U-Line.
 - c. Killark, a division of Hubbell Inc.; UGR/UGP.
- H. Ground Fault Circuit Interrupter (GFCI), Explosion-Proof:
 1. Meet requirements of general-purpose receptacle, except as otherwise indicated.
 2. Hazardous Area Ratings: NEMA 7D suitable for Class I, Group C and Group D, Class 2, Groups F and G, and Class 3 locations.
 3. Provide matching plug with each receptacle.
 4. Manufacturers and Products:
 - a. Killark; Acceptor series UGFI.
 - b. Appleton; EFSXXX-2023GFI.

2.5 DEVICE PLATES

- A. Sectional type plate not permitted.
- B. Metal:
 1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
 2. Finish: ASTM A167, Type 302/304, satin.
 3. Mounting Screw: Oval-head, finish matched to plate.
- C. Cast Metal:
 1. Material: Malleable ferrous metal with gaskets.
 2. Screw: Oval-head stainless steel.
- D. Sheet Steel:
 1. Finish: Zinc electroplate.
 2. Screws: Oval-head stainless steel.
 3. Manufacturers:
 - a. Appleton.
 - b. Crouse-Hinds.
- E. Engraved:
 1. Character Height: **3/16**-inch.
 2. Filler: **Black**.
- F. Weatherproof:
 1. Receptacle, Weatherproof Type 1:
 - a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
 - b. Mounting Screw and Cap Spring: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; Type WLRD-1.
 - 2) Appleton; Type FSK-WRD.
 2. Switch:
 - a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
 - b. Mounting Screw: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-1VTS or FSK-1VS.

2.6 FINISHES

- A. Wiring device catalog numbers specified in this section do not designate device color. Unless otherwise indicated, or required by code, provide colors as specified below.
- B. Wiring Device: Brown.
- C. Special purpose and hazardous location devices may be manufacturer's standard color (black).

- D. Corrosion-resistant receptacle may be manufacturer's standard color (yellow).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with NECA 1.
- B. Coordination with Other Trades:
 - 1. Ensure device and its box are protected. Do not place wall finish materials over device box and do not cut holes for box with router that is guided by riding against outside of box.
 - 2. Keep outlet box free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate raceway system, conductors, and cables.
 - 3. Install device box in brick or block wall such that cover plate does not cross a joint, unless otherwise indicated. Where indicated or directed to cross joint, trowel joint flush with face of wall.
 - 4. Install wiring device after wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided outlet box is large enough.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction or that show signs they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (150 mm) in length.
 - 5. Use torque screwdriver when a torque is recommended or required by manufacturer.
 - 6. When conductors larger than 12 AWG are installed on 15-amp or 20-amp circuits, splice 12 AWG pigtails for device connections.
 - 7. Tighten unused terminal screws on device.
 - 8. Device Plates:
 - a. Do not use oversized or extra deep plate.
 - b. Repair wall finishes and remount outlet box when standard device plate does not fit flush or does not cover rough wall opening.

3.2 SWITCH INSTALLATION

- A. Switch, General Purpose:
 - 1. Mounting Height: See Section 26 05 33, Raceways and Boxes.
 - 2. Install with switch operation in vertical position.
 - 3. Install single-pole, two-way switch such that toggle is in up position when switch is on.
- B. Switch, Motor Rated:
 - 1. Mounting Height: See Section 26 05 33, Raceways and Boxes.
 - 2. Install with switch operation in vertical position such that toggle is in up position when ON.

3. Install within sight of motor when used as disconnect switch.

3.3 RECEPTACLE INSTALLATION

- A. Duplex Receptacle:
 1. Install with grounding slot down, except where horizontal mounting is shown, in which case install with neutral slot up.
 2. Ground receptacle to box with grounding wire only.
3. Weatherproof Receptacle:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.
4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for “downstream” conventional receptacles.
5. Special-Purpose Receptacle: Install in accordance with manufacturer’s instructions.

3.4 DEVICE PLATE INSTALLATION

- A. Securely fasten to wiring device; ensure tight fit to box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surface without use of mat or similar material. Plaster fillings will not be acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box, unless plate has no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16 inch.
- E. Engrave with designated title.
- F. Type (Unless Otherwise Shown): Metal.
 1. Exterior:
 - a. Switch: Weatherproof.
 - b. Receptacle in Damp Location: Weatherproof Type 1.
- G. Interior:
 1. Flush Mounted Box: Metal.
 2. Surface Mounted; Cast Metal Box.
 3. Surface Mounted, Sheet Steel Box: Raised sheet steel.
 4. Surface Mounted, Nonmetallic Box: Manufacturer’s standard.
 5. Receptacle Shown as Weatherproof on Drawings: Weatherproof Type 1.

3.5 IDENTIFICATION

- A. Use tape labels for identification of individual wall switches and receptacles in dry indoor locations.
 1. Degrease and clean device plate surface to receive tape labels.
 2. Use 3/16-inch Kroy black letters on white background, unless otherwise indicated.
 3. Identify panelboard and circuit number from which item is served on face of plate.
- B. Identify conductors with durable wire markers or tags inside outlet boxes.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections, and prepare test reports.
- B. Test Instrument for 125-Volt 20-Amp Receptacle: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- C. Using test plug, verify device and its outlet box are securely mounted.
- D. Line Voltage Range: 105 volts to 132 volts.
- E. Percent Voltage Drop under 15-Amp Load: Less than 6 percent; 6 percent or higher is not acceptable.

- F. Ground Impedance: 2 ohms, maximum.
- G. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
- H. Tests shall be diagnostic, indicating damaged conductors, high resistance at circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

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SECTION 26 29 23

OWNER-FURNISHED LOW-VOLTAGE ADJUSTABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes configured VFD systems, each installed within its own enclosure, consisting of solid state VFD, HIM, fused disconnect switch, line conditioning, control power transformer, enclosure temperature control, and associated control components.
- B. For the purposes of this contract, the terms “adjustable frequency drive (AFD)” and “variable frequency drive (VFD)” are used interchangeably and refer to the same motor drives.
- C. Install adjustable frequency drives, conditioning, HIM’s and other specified elements as shown on Drawings.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Manufacturers’ Association (NEMA):
 - a. NEMA ICS 1, General Standards for Industrial Controls and Systems.
 - b. NEMA ICS 2, Standards for Industrial Control Devices, Controllers and Assemblies
 - c. NEMA ICS 3, Industrial Systems
 - d. NEMA ICS 3.1, Safety Standards for Construction and Guide for Selection, Installation and Operation of Variable-speed Drive Systems
 - e. NEMA ICS 4, Terminal Blocks for Industrial Control Equipment and Systems
 - f. NEMA ICS 6, Enclosures for Industrial Controls and Systems.
 - 2. American National Standards Institute (ANSI)
 - a. ANSI C37.90, Relays and Relay Systems Associated with Electric Power Apparatus
 - b. ANSI C37.30A (1984), Definitions and Requirements for High- Voltage Air Switches, Insulators, and Bus Supports, Supplement to C37.30-1971
 - c. ANSI C37.32, Schedules of Preferred Ratings, Manufacturing Specifications and Application Guide for High-Voltage Air Switches, Bus Supports, and Switch Accessories.
 - 3. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE 519, Harmonic Control and Reactive Compensation of Static Power Converters

1.3 SOURCE QUALITY CONTROL

- A. Listed and labeled by Underwriter’s Laboratories, Inc. (UL), ETL, or Canadian Standards Association.
- B. All upgrades to specified requirements per UL 508 or ETL.
- C. Quality Assurance: The Owner reserves the right to observe factory tests on the VFD controller at the Owner’s option and expense.
- D. Compatibility: VFD controller’s performance shall be compatible and tolerant of disturbances produced by other VFD controllers and not interfere with each other.
- E. Programming: Provide VFD controller configuration and MACRO or sub-routine programming to meet specified driven equipment requirements.
- F. Maintainability: VFD controller’s parts shall be interchangeable and modular for all controllers.
- G. Factory Test: Subject VFD to a complete simulated operational test. Drive a calibrated load at various speeds over the specified speed range to determine VFD efficiency.

1.4 SUBMITTALS

- A. Action Submittals:
1. Catalog and technical data indicating the equipment complies with the Construction Documents.
 2. Installation instructions, outline dimensions and equipment weights including reactors and harmonic filters.
 3. External connection diagram showing function and identification of all terminals requiring field connections.
 4. O&M manuals per Section 01 78 23, Operations and Maintenance Data.
 5. Schematics and wiring diagrams.
 6. Plan drawings showing conduit entry locations.
 7. Calculations of cooling and ventilation requirements.
 8. Certified final factory test procedure and results for each drive.
 9. Location and description of service center and spare parts stock.
 10. Recommended spare parts list.
 11. Factory and field test documentation.
 12. Training schedule and materials.
 13. Written descriptions explaining ladder diagram operation, system operation, and analog signal processing.
 14. Comprehensive interconnection diagrams for VFD and motor.
 15. Certification that VFD, motor, and driven load are compatible throughout the specified speed range.
 16. Certified statement from the manufacturer accepting responsibility for providing a fully functioning installation as specified herein.

1.5 COORDINATION

- A. Obtain and review the appropriate data for the driven motor and load over the required speed range, for a complete system analysis.
- B. Confirm VFD is rated for the applicable variable torque or constant torque applications.
- C. Verify that equipment is mutually compatible and free of resonance over the complete operating range. Coordinate the assignment of any critical frequencies with the motor supplier.
- D. Prepare the certificate required under Submittals paragraph in this Section; the certificate shall specifically state whether the VFD equipment is rated for variable torque or constant torque applications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/PRODUCTS

- A. Variable frequency drives shall be Rockwell Automation PowerFlex 753 or Schneider Electric Altivar ATV960 series.

2.2 VARIABLE FREQUENCY DRIVES

- A. Operation: Accomplish speed control by adjusting the output frequency according to the desired reference speed. Adjust ac voltage and frequency simultaneously to provide the constant Volts/Hertz necessary to operate the motor at the desired speed. The VFD must use pulse width modulation technology.
- B. Rating:
1. Line Voltage: 480 volts, -5 percent continuous, -10 percent momentary, +10 percent, 3-phase.
 2. Line Frequency: 60 Hz, ± 2 Hz
 3. Ambient Temperature: 5°C to 40°C
 4. Altitude: Up to 5,800 feet above sea level.

5. Power Factor: Above 0.95 at full speed and rated load.
- C. Performance:
1. Efficiency: Above 95 percent at 100 percent full speed, above 93 percent at 70 percent full speed.
 2. VFD Inrush Current: Limited to less than 100 percent of motor full load
 3. Duty Cycle: 6 starts per hour.
- D. Features:
1. Provisions to accept the following control signals for automatic and manual operation:
 - a. FWD & REV Run signal from a single remote contact closure when specified
 - b. A 4-20 mA dc signal for speed control. The VFD shall provide linear speed control of the motor from zero to full speed as the variable speed input signal varies from its minimum to maximum. Input impedance shall be 250 ohms resistive.
 2. Native Ethernet/IP connectivity.
 3. Provisions for remote speed control potentiometer. Motor speed indicator calibrated in percent of full speed.
 4. A 4-20 mA dc signal for remote speed indication to a local PLC. The VFD shall provide linear speed indication of the motor speed from zero to full speed. Input impedance shall be 250 ohms resistive.
 5. A 4-20 mA dc signal for remote motor current indication to a local PLC. The VFD shall provide linear current indication of the motor from zero to full current. Input impedance shall be 250 ohms resistive.
 6. 24 VDC control circuitry.
 7. Variable time delay for delaying motor drive restart after power failure; timer range shall be 0 to 120 seconds, with initial settings differing by 10 seconds for each drive; provide module which causes multiple attempts to restart.
 8. Provision for automatic emergency shutdown in any mode, activated by the following:
 - a. Motor thermal protection.
 - b. Any additional abnormal conditions as shown on the Drawings. Provide for manual restart.
 9. Auxiliary contacts for remote indication of "Run" and "VFD Fault."
 10. VFD able to withstand harmonic distortion and notching as defined in IEEE-519 for dedicated system (10 percent voltage distortion factor and 36,500-volt microseconds commutation notch area).
 11. VFD operable with motor disconnected, in order to test VFD.
 12. Linearity and repeatability accuracy of 3 phase output of 1 percent of analog input control signal regardless of input power voltage fluctuations between 437 and 505 volts.
 13. Independent acceleration and deceleration controls, adjustable from 2 to 30 Hz per second.
- E. Protection: Protect VFD against the following conditions:
1. Reverse phase sequence and single phasing of input power.
 2. Input power failure.
 3. Input transient voltages, including peak suppression and snubbers, in accordance with ANSI C37.90.
 4. Transmission signal interference.
 5. Output overcurrent.
 6. Input overcurrent.
 7. Motor over temperature.
 8. Cabinet over temperature.
 9. Under voltage: VFD shall automatically shut down if input voltage falls below preset limit with automatic restart upon return to a stable supply.
- F. Enclosure:
1. Installed as stand-alone unit: NEMA Type 12
 2. Installed as element of VFD configured system: Refer to paragraph Configured VFD System.

- G. HIM
 - 1. Provide HIM with the following indications.
 - a. Power On
 - b. Speed indication

2.3 CONFIGURED VFD SYSTEM

- A. Provide integrated VFD system with solid state VFD, HIM, fused disconnect switch, line/load conditioning, control power transformer, enclosure temperature control, and associated control components. Each VFD system shall be installed within its own individual enclosure. System shall comply with NEMA ICS 1, 3, 3.1, 4, and 6.
- B. Variable Frequency Drive and HIM: As specified above.
- C. Enclosure:
 - 1. Housing controller modules and components shall be free-standing, wall-mounted, NEMA 12 gasketed and fabricated from steel, 12-gauge minimum.
 - 2. Dead front and dead back construction with all modules, components, load, line, and control terminations fully front accessible.
 - 3. Fan-vented with axial fan controlled via thermostat.
 - 4. Provision for top and bottom entry of wiring and conduits.
 - 5. Gasketed doors mounted on semi-concealed hinges, with lockable door latches.
 - 6. Door interlocking: Interlock mechanically so door cannot be opened with unit energized. Provide defeater mechanism to allow intentional access at any time.
 - 7. Door-mount the following devices:
 - a. HIM.
 - b. Control devices and indication: As shown on Drawings.
 - c. External operating handle for the incoming line fused disconnect switch.
 - 8. Configuration of the enclosure and the components shall be as shown on the drawings.
 - 9. Components: Mount components on circuit cards or modules, which can be adjusted or replaced in the field without the use of special tools.
 - 10. Finish: Paint finish shall be ANSI Gray.
- D. Incoming line fused disconnect switch:
 - 1. External disconnect handle, padlocked in OFF position.
- E. Conditioning:
 - 1. Provide 5 percent nominal reactance power input series line reactor.
 - 2. Provide 3 percent nominal reactance series load reactor where shown on the Drawings.
- F. Control Power Transformers (CPT):
 - 1. Two winding, 120-volt secondary, primary voltage to suit.
 - 2. Two current-limiting fuses for primary circuit.
 - 3. One fuse in secondary circuit.
 - 4. All fuses shall be provided with blown fuse indicators.
 - 5. Size for load shown on motor control schematics.
- G. Spare Parts: Furnish two sets of spare power fuses for each size and type of fuse used; furnish a minimum of five fuses of each size and type of control circuit fuse.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Enclosure shall be fully wired to all field devices as indicated by the Drawings.
- C. Protect the internal panel components from metal shavings, liquids and construction debris at all times.

- D. Properly level and plumb VFDs so that doors will open and close freely and are in longitudinal alignment with pad or wall.
- E. Clean and repair scratched or damaged surfaces to "new" condition
- F. Secure enclosure hardware of sufficient size and number for specified seismic conditions.
- G. Provide the services of a factory trained service technician to inspect and check out each system before energizing.
- H. Per manufacturer's instructions, lace power conductors to resist short circuit forces.
- I. Operate each drive from no load to full load and perform a spectrum analysis to verify line side waveform complies with IEEE 519 for general systems.
- J. Provide and install batteries in factory I/O cards as required to maintain time and date settings.
- K. Label with fault current rating and arc flash warning per Section 26 05 73, Electrical Systems Analysis.
- L. Label denoting overload setting and date it was set.

3.2 IDENTIFICATION

- A. Install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual on each enclosure.

3.3 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative for startup services:
 - 1. Physical inspection and verification of proper drive and motor installation practices prior to application of power.
 - 2. Verification of external control wiring.
 - 3. Confirmation of drive cabling to motor and line feed.
 - 4. Incoming line and drive output grounding checks.
 - 5. Voltage application, checkout, calibration, and testing of the drive as appropriate for the application.
 - 6. Tune-up of drive internal regulating loops as appropriate for the application.
 - 7. Adjustment of operation parameters, with drive and motor design limitations, to values as appropriate for the application.
 - 8. Operation of drive through speed range to verify proper performance.
 - 9. Documentation of drive and motor nameplate information, application information, drive settings, and operating parameters.
 - 10. Provide confirmation the drives have been properly installed.
- B. Provide 3 person-days for installation inspection and prestart-up classroom training at site or classroom as designated by Owner, travel time excluded.
- C. Furnish startup services and training of Owner's personnel at such times as requested by Owner to accommodate the shift schedules of Owner's operation and maintenance staff.

END OF SECTION

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SECTION 26 35 26
ACTIVE HARMONIC FILTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies requirements necessary to provide:
1. Active harmonic filter power correction systems to reduce current harmonics and correct power factor on 480-volt power distribution systems.
 2. Manufacturer's services.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. IEEE C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 2. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.
 3. CSA 22.2: No. 14 & 66, Industrial Control Equipment & Specialty Transformers, Industrial Products
 4. UL 508, Industrial Control Equipment
 5. IEC 60529, IP20, Degrees of Protection Provided by Enclosures (IP Code)
 6. ICC IBC, International Building Code

1.3 FACTORY TESTS:

- A. The manufacturer shall test the system performance at rated current and voltage while functioning as a harmonic correction device prior to shipment. A certified report shall be submitted at the successful completion of factory performance tests.

1.4 SUBMITTALS

- A. Action Submittal:
1. Electrical single line, schematic diagrams, and conductor connection diagram.
 2. Layout drawings indicating arrangement, dimensions, cable entries, and weights.
 3. Manufacturer's product and catalog data indicating equipment specifications and features.
 4. Provide size and weights of shipping units to be handled by installer. Detailed layouts of customer power and control connections. Detailed installation drawings including all terminal locations.
 5. Operation and maintenance information as specified in Division 1 including:
 - a. As-built drawings.
 - b. Final, complete reviewed submittal information.
 6. Factory test report and field test reports.

1.5 QUALIFICATIONS

- A. Manufacturer providing harmonic correction equipment of the type specified, with minimum 5 years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. TCI Harmonic Guard, or approved equivalent with native Ethernet IP communication interface.

2.2 DESIGN FEATURES

- A. System description: System Voltage: 480 volts, 3-Phase, 3-Wire plus ground conductor.

- B. Output load capacity: Rated capacity shall be the specified current capacity at the voltage required as indicated within this specification and shown on the respective electrical drawings included within this document.
- C. Current transformers:
1. Two split core type current transformers rated for 50 to 400-Hertz shall be installed on phases A & B at locations shown. 1% or better (metering class) accuracy shall be provided.
 2. Current transformer current ratings based on based on full load current rating of the installed circuit/bus or as shown.
 3. Current transformer output shall be 5 amperes full scale.
 4. Current transformers shall be dedicated for AHF operation and not shared with other system components.
 5. When active filters are shown to be connected for future parallel operation, CT burden rating shall be appropriate for the number of units shown.
- D. Modes of operation:
1. The power correction system shall inject harmonic current to cancel load produced harmonic current so the upstream power harmonic current and voltage are reduced to below 5% TDD and 5% THD(V), respectfully. The system shall correct all types of nonlinear loads.
 2. The applied circuit may be a single nonlinear load, a distribution-bus with multiple loads, or the facility load at the point-of-common coupling (PCC) with the power source.
 3. The displacement power factor correction of the reactive current shall be activated or deactivated via a door-mounted human machine interface (HMI) with touch screen control.
- E. Performance requirements:
1. Input Power:
 - a. Voltage: Automatically adapted to 480V, 3 phase, 3-wire plus ground conductor.
 - b. Voltage Tolerance: +/- 10% of nominal.
 - c. Frequency: automatically adapted to 60 Hertz, +/- 3 Hertz.
 - d. Surge Withstand Capability: ANSI/IEEE C62.41-1991 without damage.
 - e. Input Fuses: Class T rated at 200,000 AIC (amperes interrupting capacity).
 2. Output Performance: Performance of the power correction system shall be independent of the impedance of the power source.
 3. Harmonic Correction:
 - a. Limit the 3rd through 49th order harmonic current to <5% TDD at the main bus. Harmonic levels for individual harmonic orders shall comply with respective levels established in ANSI/IEEE std 519-1992, Table 10.3.
 - b. Limit the THD(V) added to the electrical system immediately upstream of the power correction system location(s) to less than or equal to 5%.
 - c. The power correction system shall not correct for power utility supplied voltage distortion levels.
 4. Reactive Current Compensation: Maintain a set point of .99 lagging displacement power factor under all load conditions. Power factor shall not go "leading" at any point.
 5. Filters shown to operate in tandem (tie closed) or independently shall have all necessary wiring to achieve this requirement.
- F. System Features:
1. Each unit provided with a current limiting function to protect the semiconductors.
 2. Non-critical level faults (AC line over/under voltage, power loss, and phase imbalance) shall provide automatic restart and return to normal operation upon automatic fault clearance.
 3. Critical level faults shall stop the function of the unit and await Operator action to restart the power correction system.
 4. The ratio of the two CTs shall be entered into the logic via the digital keypad/display to calibrate the operation of the power correction system.

G. Indicators and Controls:

1. Features:
 - a. Door-mounted color touchscreen display.
 - b. Configurable network-based run/stop control
 - c. Manual and auto run/stop control
 - d. Power quality information
 - e. Configuration parameters
 - f. Operational measurements, status, and alarms/fault.
 - g. Display trend history for line voltage, line current, filter current, filter voltage, THD, and filter heatsink temperature.
2. Control modes:
 - a. Harmonic correction only
 - b. Power factor correction only
 - c. Combination harmonic and power factor
3. Native Ethernet IP interface for remote communications. Protocol converters and gateways used to convert from other protocols will not be accepted.
4. Two form C, 2-amp, 120VAC, dry relay output contacts for remote indication of system run, fault, and maximum load status contacts.
5. Remote enable input.

H. Enclosure:

1. Each unit shall be provided in a wall mounted NEMA 1 gasketed enclosure with bottom entry. Provide floor stand from manufacturer as required.
2. Disconnects:
 - a. The switchgear or MCC feeder circuit breaker shall be utilized as the local disconnecting means. A mechanism shall be provided that locks the AHC door when the unit is energized.
3. Lifting Provisions:
 - a. Freestanding units shall include lifting provisions by lifting lugs.
 - b. Wall mount units weighing more than 80 pounds shall have lifting lugs.
4. Features:
 - a. 200,000 AIC rated fuses with Class T actuation.
 - b. Grounding lug.

I. Nameplates:

1. In addition to the manufacturer's identification, an external nameplate conforming to the requirements of Section 26 05 00 shall be provided with equipment number and name as shown

2.3 SPECIAL WARRANTY

- A. Manufacturer shall warrant against defects in materials and workmanship for two (2) years.

PART 3 - EXECUTION

3.1 DELIVERY

- A. Active harmonic conditioners shall be factory assembled.
- B. Factory test results shall be reviewed and accepted by Seller before active harmonic conditioner shipment.

3.2 INSTALLATION

- A. Take all necessary precautions to exclude moisture and foreign material from the equipment at all times during storage and installation. Care shall be taken to prevent corrosion of silver-plated contact surfaces and damage to relays and control devices.
- B. Install in accordance with the manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Provide field quality control as part of manufacturer's services.
- B. Inspect completed installation for any physical damage, proper alignment, anchorage, and grounding.

3.4 STARTUP AND SITE TESTING

- A. Installation, Start up and Testing Services:
 - 1. Provide complete manufacturer' s installation and startup services. Coordinate all manufacturer' s recommended testing services with those provided under Section 26 08 00, Commissioning of Electrical Systems.
 - 2. Provide Manufacturer's Certificate of Proper Installation.
- B. Training Services:
 - 1. Provide training of OWNER's personnel.
 - 2. Provide 0.5-person days of installation inspection and prestart up training, which shall be provided in one session.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTIVE DEVICES (SPDs) 1000V OR LESS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide SPD with electrical characteristics and ratings for service entrance equipment, switchboards, switchgear, motor control centers, and panelboards specified in the Division 26 electrical distribution equipment specification sections or indicated on the Drawings. Provide SPD with the same voltage, phase, 3 or 4 wire system as the host electrical equipment.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE):
1. C62.41 - Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.
 2. C62.45 - Guide on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
 3. C62.62 - Standard Test Specifications for Surge Protective Devices for Low Voltage AC Power Circuits.
- B. Underwriters Laboratory: 1449, Standard for Surge Protective Devices.
- C. National Fire Protection Association (NFPA): 70, Electrical Code (NEC).

1.3 SUBMITTALS

- A. Action Submittals:
1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL).
 2. Compliance: File number verified on UL's website or other NRTL's website, with the following information:
 - a. Model number
 - b. SPD Type
 - c. System voltage, phases
 - d. Protection modes
 - e. Voltage Protection Rating (VPR)
 - f. Nominal Discharge Current (In).
 - g. Name of nationally recognized testing lab that performed the test.
 3. For side mount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
 4. Final Record as-built drawings and information.
 5. Operation and maintenance manuals shall be provided with each SPD shipped.

1.4 SPECIAL WARRANTY

- A. Manufacturer shall warrant against defects in materials and workmanship for ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly unless noted otherwise.
- B. The manufacturer shall be ISO 9001 or ISO 9002 certified for the equipment specified herein.

- C. The manufacturer shall have produced similar electrical equipment for a minimum period of five years.
- D. The listing of manufacturers does not imply acceptance of products that do not meet the specified ratings, features, and functions. Manufacturers listed shall meet the specifications in their entirety.
- E. Manufacturers:
 - 1. Square D, Surelogic
 - 2. Eaton, SPD Series
 - 3. General Electric, Tranquell
 - 4. Or approved equivalent

2.2 SURGE PROTECTIVE DEVICES

- A. Electrical requirements:
 - 1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.
 - 2. MCOV:
 - 3. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.
 - 4. Operating frequency:
 - 5. 47 to 63 hertz.
 - 6. SCCR:
 - 7. Not less than the equipment it is connected to as indicated on the Drawings.
 - 8. The SCCR shall be marked on the SPD in accordance with UL 1449 and the NEC.
 - 9. Power Filter: Include a high-frequency extended range power filter for each SPD complimentary listed to UL 1283 as an electromagnetic interference filter.
 - 10. Provide UL type 2 SPD's.
 - 11. Maximum VPR:

Modes	240/120	208Y/120	480Y/277
L-N, L-G, N-G	800	800	1,200
L-L	1,200	1,200	2000

- B. Protection modes:
 - 1. Provide SPD protection modes as follows:
 - 2. Line to Neutral (L-N) where applicable.
 - 3. Line to Ground (L-G).
 - 4. Neutral to Ground (N-G), where applicable.
- C. Environmental requirements:
 - 1. Storage temperature:
 - a. -40 degrees to +50 degrees Celsius.
 - b. Operating temperature:-0 degrees to +60 Celsius.
 - 2. Relative humidity:
 - a. 5 percent to 95 percent.
 - 3. Audible noise:
 - a. Less than 45 dBA at 5 feet (1.5 m).
 - 4. Operating altitude:
 - a. Zero to 12,000 feet above sea level.
- D. Enclosure:
 - 1. Located in electrical equipment as indicated on the Drawings.
- E. Internal connections:
 - 1. Provide low impedance copper plates for intra-unit connections:

- a. Attach surge modules using bolted connections to the plates for low impedance connections.
- 2. Size all connections, conductors, and terminals for the specified surge current capacity.
- F. Surge diversion modules:
 - 1. MOV:
 - a. Where multiple MOVs are used in parallel, utilize computer matched MOVs to within 1-volt variance and tested for manufacturer's defects.
- G. Overcurrent protection:
 - 1. Individually fuse all components, including suppression, filtering, and monitoring components:
 - a. Rated to allow maximum specified nominal discharge current capacity.
 - b. Overcurrent protection that limits specified surge currents is not acceptable.
- H. Connections:
 - 1. Provide terminals to accommodate wire sizes up to #2 AWG.
- I. Unit status indicators:
 - 1. Provide red and green solid-state indicators, with printed labels, on the front cover to redundantly indicate on-line unit status:
 - a. The absence of the green light and the presence of the red light indicate that surge protection is reduced and service is needed to restore full operation.
 - b. Indicates the status of protection on each mode or phase.
- J. Dry contacts for remote monitoring:
 - 1. Electrically isolated Form C dry contacts (1 A/125 VAC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.
- K. Provide transient counter to count transient voltage surges:
 - 1. LCD readout located on the unit's front cover.
 - 2. Counter to utilize batteries with a 10-year nominal life or non-volatile memory to maintain accurate counts in the event of power loss.
- L. Provide surge protective devices that are suitable for application in IEEE C62.41 Category A, B and C3 environments, as tested to IEEE C62.45.
- M. Verify SPD's are compatible with active harmonic filters.

2.3 PANELBOARDS

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 location in accordance with Category B.
- B. Surge Current Capacity:
 - 1. Distribution: 120 kA per phase, minimum; 60 kA per mode.
 - 2. Branch: 80kA per phase; 40kA per mode
- C. Nominal discharge current I_n : 10 kA.
- D. SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
- E. SPD's installed following the load side of the main breaker and in main lug only panelboards installed following the incoming main lugs.
- F. SPD interfaced to the panelboard via a manufacturer sized circuit breaker for disconnecting purposes shall be installed using short lengths of conductors integrally to the SPD and located directly adjacent to the circuit breaker.
- G. SPD shall be mounted within the panelboard by the manufacturer.
- H. Panelboard including the SPD shall be UL67 listed.

2.4 SERVICE ENTRANCE SWITCHGEAR, SWITCHBOARD, AND MCC

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 location in accordance with Category C.
- B. Surge Current Capacity: 200 kA per phase; 100 kA per mode.
- C. Nominal discharge current I_n : 20 kA.
- D. SPD shall be factory installed inside or adjacent to the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer. Location of SPD shall be such that it does not require de-energization of switchgear, switchboard, MCC or panelboard for replacement.
- E. Locate SPD on the load side of the main disconnect device, close to the phase conductors and the ground/neutral bar.
- F. SPD connected through a circuit breaker or fused disconnect with current limiting fuses located in immediate proximity to SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD shall be as short as possible per the factory specifications.
- G. Monitoring and diagnostic features shall be visible on the front of equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Host equipment Manufacturer's representative shall visit the site, verify installation and testing, and verify that the SPD equipment and SPD installation meets intent of the Contract Documents and manufacturer's warranties and that the guarantees are in effect.

3.2 INSTALLATION

- A. Install according to manufacturer's recommendations.
- B. Lead lengths shall not exceed manufacturer's recommendation.
- C. Electrical equipment manufacturer shall authorize and perform bus taps connections, as necessary.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Solid-state luminaires that use LED technology.
 2. Lighting fixture supports.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Canadian Standards Association (CSA).
 2. Certified Ballast Manufacturer (CBM).
 3. Federal Communications Commission (FCC).
 4. Illuminating Engineering Society of North America (IESNA).
 5. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 6. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 7. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
 8. Underwriters Laboratories, Inc. (UL):
 - a. 1598, Luminaires.
 - b. 595, Marine-Type Electric Lighting Fixtures.
 - c. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 - d. 924, Emergency Lighting and Power Equipment.
 - e. 8750, Light Emitting Diode (LED) Equipment For Use in Lighting Products.

1.3 SUBMITTALS

- A. Action Submittals:
1. General:
 - a. Mounting and suspension details.
 - b. Arrange in order of luminaire designation.
 - c. Include data on features, accessories, and finishes.
 - d. Include physical description and dimensions of luminaires.
 - e. Include emergency lighting units, including batteries and chargers.
 - f. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - g. Photometric data and adjustment factors based on laboratory tests
 2. Shop Drawings:
 - a. Interior Luminaires:
 - 1) Catalog data sheets and pictures.
 - 2) Luminaire finish and metal gauge.
 - 3) Lens material, pattern, and thickness.
 - 4) Candle power distribution curves in two or more planes.
 - 5) Candle power chart 0 degrees to 90 degrees.
 - 6) Lumen output chart.
 - 7) Average brightness data in foot lamberts.
 - 8) Coefficient of utilization for zonal cavity calculations.
 - b. Exterior Luminaires:
 - 1) Catalog data sheets and pictures.
 - 2) Luminaire finish and metal gauge.
 - 3) Lens material, pattern, and thickness.

- 4) IESNA lighting classification and isolux diagram.
 - 5) Distribution data according to classification type as defined in IESNA HB-9.
 - 6) Fastening details to wall or pole.
 - 7) Light pole catalog data sheets including wind loading, complete dimensions, and finish.
 - c. Lighting Contactors:
 - d. Photocells:
 - 1) Voltage, and power consumption.
 - 2) Capacity.
 - 3) Contacts and time delay.
 - 4) Operating levels.
 - 5) Enclosure type and dimensions.
 - 6) Temperature range.
 - e. Occupancy Sensors:
 - 1) Type.
 - 2) Switching capacity.
 - 3) Coverage.
 - 4) Time delay AUTO/OFF adjustment.
3. Samples: Submit Samples of each substituted luminaire if requested by Engineer.
- B. Informational Submittals:
- 1. Seismic anchorage and bracing calculations.
 - 2. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Sample warranty.
- C. Closeout Submittals:
- 1. Operation and maintenance data. For luminaires and lighting systems to include in operation and maintenance manuals.
 - a. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
 - b. Provide a list of all photoelectric relay types used on Project; use manufacturer's codes.

1.4 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
- 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
- B. Preinstallation Meeting:
- 1. Occupancy Sensors: Arrange preinstallation meeting with manufacturer's factory authorized representative at Owner's facility, to verify placement of sensors and installation criteria.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General:
- 1. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- B. Poles:

1. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.
2. Do not store poles on ground.
3. Support poles so they are at least 1 foot above ground level and growing vegetation.
4. Do not remove factory-applied pole wrappings until just before installing pole.
5. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRES REQUIREMENTS

- A. Specific performance requirements relative to execution of the Work are located in Luminaire Schedule on Drawings. All luminaires shall be LED, unless noted otherwise.
- B. Component Access: Accessible and replaceable without removing luminaire from its mounting.
- C. 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.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. Recessed Fixtures: Comply with NEMA LE 4.
- G. Bulb shape complying with ANSI C79.1.
- H. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- I. CRI, CCT, and rated lamp life shall meet or exceed those listed in the Luminaire Schedule.
- J. L70 lamp life of 50,000 hours.
- K. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- L. Internal driver.
- M. Nominal Operating Voltage: As shown on Drawings.
- N. Feed-through type, or separate junction box.
- O. Wire Leads: Minimum 18 AWG.
- P. Component Access: Accessible and replaceable without removing luminaire from ceiling.

- Q. Hazardous Classified Areas:
 - 1. UL labeled: CLASS 1, DIVISION 1, GROUPS C AND D.
 - 2. Fixture Enclosure and Fittings: Copper-free, cast aluminum in accordance with UL 844.
- R. Soffit Installations: UL labeled SUITABLE FOR WET LOCATIONS
- S. Exterior Installations: UL Labeled: SUITABLE FOR WET LOCATIONS. When factory-installed photocells are provided, entire assembly shall have UL label.
- T. Emergency Lighting:
 - 1. Power Pack: Self-contained, 120/277-volt dual voltage transformer, inverter/charger, sealed battery, and indicator switch in accordance with UL 924.
 - 2. Lighted, push-to-test indicator.
 - 3. Capable of providing full illumination for 1-1/2 hours in emergency mode.
 - 4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.
 - 5. Capable of protecting against excess charging and discharging.
 - 6. Emergency Self-Diagnostic System:
 - a. Solid state device with LED display and audible alarm.
 - b. Automatic and manual test unit.
 - c. Test for malfunction of lamps, battery, and charger board.
 - d. Manufacturer: Lithonia.

2.3 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
 - 4. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
 - 5. Housings:
 - a. Rigidly formed, weather and light-tight enclosure that will not warp, sag, or deform in use.
 - b. Provide filter/breather for enclosed outdoor luminaires.
 - 6. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - a. Label shall include the following lamp characteristics:
 - 1) "USE ONLY" and include specific lamp type.
 - 2) Lamp diameter, shape, size, wattage, and coating.
 - 3) CCT and CRI for all luminaires.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Match finish process and color of pole or support materials.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- B. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

- C. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.6 IN-LINE FUSE HOLDER AND FUSE

- A. Fuse Holder:
 - 1. General: Waterproof, of corrosion-resistant material.
 - 2. Rating: 600 volts.
- B. Fuse:
 - 1. General: Midget, dual element.
 - 2. Rating: 5-amp, voltage as required by application.
- C. Manufacturer: Methods Electronics Inc. Network, Buss Div.

2.7 EQUIPMENT IDENTIFICATION

- A. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.
- B. Markings shall be clear and located to be readily visible to service personnel.

2.8 FACTORY FINISH

- A. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

2.9 SPARE PARTS

- A. The Contractor shall supply the following spare parts for use by the Owner. These are to be boxed and labeled with the applicable fixture type on them and delivered to the Owner upon the completion of the project.
 - 1. One spare LED driver for each fixture type.
 - 2. One spare emergency driver for each fixture type.

PART 3 - EXECUTION

3.1 LUMINAIRES

- A. General:
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. Provide proper hangers, pendants, and canopies as necessary for complete installation and meeting specified seismic requirements.
 - 3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to pole concrete bases required to safely mount.
 - 4. Install plumb and level.
 - 5. Install each luminaire outlet box with galvanized stud.
- B. Mounting:
 - 1. General:
 - a. Mounting, fastening, and environmental conditions shall be coordinated.
 - 2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.
 - 3. Pendant Mounted:
 - a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
 - b. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
 - c. Provide twin-stem hangers on single luminaires.
 - d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.

4. Pole Mounted:
 - a. Provide cast-in-place concrete base.
 - b. Poles in straight runs shall be in a straight line.
 - c. Provide branch circuit in-line fuses in pole base handhole.
- C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.
- D. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
 1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
 2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.
- E. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.
- F. Grounding: Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, Grounding and Bonding for Electrical Systems. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.2 EMERGENCY LIGHTING UNIT

- A. Install in accordance with manufacturer's recommendations.
- B. Provide permanent circuit connections with conduit and wire.
- C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.
- D. Provide separate circuit wiring to luminaire.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.
- B. Coordinate lighting and controls installation and testing with commissioning.

3.4 CLEANING

- A. Remove labels and markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.
- C. Clean luminaire plastic lenses with antistatic cleaners only.
- D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.
- E. Replace defective lamps at time of Substantial Completion.

END OF SECTION



DIVISION 31

EARTHWORK



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SECTION 31 10 00 SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site clearing, tree protection, stripping topsoil and demolition.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 00 - Earthwork.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing trees and other vegetation to remain against damage.
 - 1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
 - 2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
 - 3. Provide temporary protection as required.
- B. Repair or replace trees and vegetation damaged by construction operations.
 - 1. Repair to be performed by a qualified tree surgeon/licensed arborist.
 - 2. Remove trees which cannot be repaired and restored to full-growth status.
 - 3. Replace with new trees of minimum 4 IN caliper or as required by local tree ordinance.
- C. Owner will obtain authority for removal and alteration work on adjoining property, as applicable.

3.2 SITE CLEARING

- A. Topsoil Removal:
 - 1. Strip topsoil to depths encountered or as specified within the soils report, 4 IN minimum.
 - a. Remove heavy growths of grass before stripping.
 - b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
 - c. Separate from underlying subsoil or objectionable material.
 - 2. Stockpile topsoil where directed by Engineer.
 - a. Construct storage piles to freely drain surface water.
 - b. Seed or cover storage piles to prevent erosion.
 - 3. Do not strip topsoil in wooded areas where no change in grade occurs.
 - 4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.
- B. Clearing and Grubbing:
 - 1. Clear from within limits of construction all trees not marked to remain.
 - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
 - 2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
- C. Disposal of Waste Materials:

1. Do not burn combustible materials on site.
2. Remove all waste materials from site.
3. Do not bury organic matter on site.

END OF SECTION

SECTION 31 22 00

SITE GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Earthwork - site excavation, grading, compaction, disposal of waste and surplus materials, construction of berms, dewatering and other Earthwork related work.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 10 - Excavation and Backfill.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C33, Standard Specification for Concrete Aggregates.
 - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/CUFT).
 - c. D1241, Standard Specification for Material for Soil-Aggregate Subbase, Base, and Surface Courses.
 - d. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/CUFT (2,700 kN-M/M)).
 - e. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - f. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
 - g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - h. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - i. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 2. American Association of State Highway and Transportation Officials (AASHTO)
 - a. M 43, Standard Specification for Sizes of Aggregate for Road and Bridge Construction.
 - b. M 57, Standard Specification for Materials for Embankment and Subgrades.
 - c. M 147, Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.
- B. Federal Regulations:
 - 1. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926.650, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- C. Building code:
 - 1. International Code Council (ICC):
 - a. International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.

1.3 DEFINITIONS

- A. Excavation:
 - 1. Consists of removal of material encountered to subgrade or rough grade elevations required or indicated.

- 2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.
- B. Geotechnical Engineer: Independent geotechnical specialist providing field quality control for the project.
- C. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving, or other flatwork.
- D. Finish Grade: The earth or soil layer immediately below the surfacing material of the site.
- E. Rough Grade: The earth or soil layer immediately below the finish grade surface.
- F. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.
- G. Unauthorized Excavation:
 - 1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
 - a. Unauthorized excavation, as well as associated remedial work as directed by Engineer or Geotechnical Engineer, shall be at Contractor's expense.
 - 2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Geotechnical Engineer.

1.4 SUBMITTALS

- A. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. Product Data:
 - 1. Acknowledgement that products submitted meet requirements of standards referenced.
 - 2. Manufacturer's installation instructions.
 - 3. Certifications.
 - 4. Test reports.
 - a. Report and certification of aggregate fill.
 - b. Test reports on borrow material.
 - c. Field reports; in-place soil density and moisture tests.
 - d. One optimum moisture-maximum density curve for each type of soil encountered.
 - e. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
- C. 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.

1.5 PROJECT CONDITIONS

- A. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.
- B. Dispose of waste materials, legally, off site.
 - 1. Burning, as a means of waste disposal, is not permitted.
- C. Site Information:
 - 1. Data in subsurface investigation reports was used for the basis of the design.
 - a. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
 - b. The Owner or Engineer will not be responsible for interpretations or conclusions drawn from this data by Contractor.

2. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
3. Site data provided is not contractual and shall be considered "for information only."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill:
 1. Selected on-site material from site excavation or from off-site borrow approved by Geotechnical Engineer.
 2. Structural Fill:
 - a. May be low volume change cohesive or granular soil at Contractor's option.
 - b. Free of organic matter, frozen material and debris.
 - c. Low volume change cohesive soil:
 - 1) ASTM D2487 classification: CL-ML or CL.
 - 2) Liquid limit: Less than 45.
 - 3) Maximum plasticity index: 20.
 - d. Granular soil:
 - 1) ASTM D2487 classification: GW, GP, GM, GC, SW, SP, SM or SC.
 3. Non-Structural Fill:
 - a. ASTM D2487 classification: GW, GP, GM, GC, SC, SW, SP, SM, CL-ML or CL.
 - b. Liquid limit: Less than 45.
 - c. Maximum plasticity index: 20.
- B. Aggregate Base:
 1. Granular Fill Material:
 - a. Clean, Granular material.
 - b. Less than 5 PCT fines passing the No. 200 sieve.
 - c. ASTM D1241/AASHTO M147 Grading "B" or other material acceptable to Geotechnical Engineer.
 - d. Crushed Stone Surfacing:
 - 1) See Specification 31 15 40.
- C. Geotextile Filter Fabric:
 1. Nonwoven type.
 2. Equivalent opening size: 50 - 100 (U.S. Standard Sieve).
 3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.
 4. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632 requirements.
 5. Mullen burst strength: 125 PSI minimum in accordance with ASTM D3786 requirements.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
 2. Protect and maintain bench marks, monuments or other established reference points and property corners.
 - a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
 3. Verify location of utilities.
 - a. Omission or inclusion of utility items does not constitute nonexistence or definite location.

- b. Secure and examine local utility records for location data.
 - c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
 - 1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
 - 2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
 - 3) Obtain Owner's approval prior to disconnecting any utility service.
 - d. Repair damages to utility items at own expense.
 - e. 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.
 - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
 - c. 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.

3.2 SITE EXCAVATION AND GRADING

- A. The site excavation and grading work includes the offsite disposition of all material:
 1. That exceed quantities required for earthwork on the project.
 2. That the engineer classifies as unclassified excavation.
 3. That the engineer classifies as unacceptable.
 4. That the engineer classifies as potentially contaminated.
- B. Excavation and Grading:
 1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
 - a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
 - b. Perform other layout work required.
 - c. Replace property corner markers to original location if disturbed or destroyed.
 2. Preparation of ground surface for embankments or fills:
 - a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
 - b. 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:
 - a. During construction, shape and drain embankment and excavations.
 - b. Maintain ditches and drains to provide drainage at all times.
 - c. Protect graded areas against action of elements prior to acceptance of work.
 - d. Reestablish grade where settlement or erosion occurs.
- C. Borrow:
 1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
 2. Include cost of all borrow material in original proposal.

- 3. Fill material to be approved by Geotechnical 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.
 - a. 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.
 - a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
 - b. Do not place material in layers greater than 8 IN loose thickness.
 - c. Place layers horizontally and compact each layer prior to placing additional fill.
 - 3. Compact soils as required to obtain specified density. Selection of appropriate equipment is the Contractor's responsibility.
 - a. In general, compact cohesive soils by sheepsfoot, and granular soils by pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
 - b. Control moisture for each layer necessary to meet requirements of compaction.
- E. Grading Tolerances: as shown on Drawings.

3.3 USE OF EXPLOSIVES

- A. Blasting with any type of explosive is prohibited.

3.4 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from Geotechnical 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 Geotechnical Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by Geotechnical Engineer.
- E. Assure by results of testing that compaction densities comply with the following requirements:
 - 1. Sitework:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Subgrade:		
Cohesive soils	90 PCT per ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	65 PCT relative density per ASTM D4253 and ASTM D4254	
Rough Grade:		
Cohesive soils	95 PCT of ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	75 PCT relative density per ASTM D4253 and ASTM D4254	
Finish Grade:		
Cohesive soils	95 PCT of ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	75 PCT relative density per ASTM D4253 and ASTM D4254	

3.5 FIELD QUALITY CONTROL

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA standards 29 CFR Part 1926.650 Subpart P, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.
- B. Special Inspection and testing:
 - 1. See Section 01 45 33.
- C. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
- D. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.
- E. Responsibilities of Special Inspector:
 - 1. Review proposed materials for fill and backfill around structures.
 - 2. All testing, observation and work indicated as being performed by the testing firm.
 - 3. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
 - 4. Moisture density relations, to be established by the Engineer required for all materials to be compacted.
 - 5. Extent of compaction testing will be as necessary to assure compliance with specifications.
 - 6. Make at least one field density test on subgrade and each compacted fill layer for every 2000 SQ FT.
 - 7. Prepare and submit inspection and test reports to Engineer.
 - a. Coordinate such work with other Special Inspectors.
 - 8. Test reports to include the following:
 - a. Report and certification of aggregate fill and drainage fill.
 - b. Test reports on borrow material.
 - c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - d. Field reports; in-place soil density and moisture tests.
 - e. One optimum moisture-maximum density curve for each type of soil encountered.
 - f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
 - g. Other documentation necessary for Geotechnical Engineer to approve earthwork.
 - h. Assist Engineer to determine corrective measures necessary for defective work.
- F. Should any compaction density test or subgrade inspection fail to meet specification requirements, perform corrective work as necessary, at no additional expense to Owner.
- G. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.
- H. Responsibilities of Testing Agency for Site Excavation and Grading:
 - 1. All testing, observation and work indicated as being performed by the testing firm.
 - 2. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
 - 3. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
 - 4. Extent of compaction testing will be as necessary to assure compliance with specifications.

END OF SECTION

SECTION 31 23 00

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Earthwork - excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, sheeting, bracing, dewatering and other Earthwork related work.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 26 00 - Under Slab Vapor Retarder.
 - 4. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C33/C33M, Standard Specification for Concrete Aggregates.
 - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³).
 - c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT³(2,700 kN-M/M³)).
 - d. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - e. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
 - f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - h. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 2. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015Edition including all amendments, referred to herein as Building Code.
 - 3. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926.650, Safety and Health Regulations for Construction - Excavations, referred to herein as OSHA Standards.

1.3 DEFINITIONS

- A. Excavation:
 - 1. Consists of removal of material encountered to subgrade elevations required or indicated.
 - 2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.
- B. Foundations: Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.
- C. Geotechnical Engineer: Independent geotechnical specialist providing field quality control for the project.

- D. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving, or other flatwork.
- E. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.
- F. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.
- G. Unauthorized Excavation:
 - 1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
 - a. Unauthorized excavation, as well as associated remedial work as directed by Engineer or Geotechnical Engineer, shall be at Contractor's expense.
 - 2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Geotechnical Engineer.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Certifications.
- 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.
 - 3. Test reports.
 - a. Report and certification of aggregate fill and drainage fill.
 - b. Test reports on borrow material.
 - c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - d. Field reports; in-place soil density and moisture tests.
 - e. One optimum moisture-maximum density curve for each type of soil encountered.
 - f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.

1.5 PROJECT CONDITIONS

- A. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.
- B. Dispose of waste materials, legally, off site.
 - 1. Burning, as a means of waste disposal, is not permitted.
- C. Site Information:
 - 1. Data in subsurface investigation reports was used for the basis of the design.
 - a. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
 - b. The Owner or Engineer will not be responsible for interpretations or conclusions drawn from this data by Contractor.
 - 2. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
 - 3. Site data provided is not contractual and shall be considered "for information only."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill and Backfill:
 - 1. Selected material approved by Geotechnical Engineer from site excavation or from off site borrow.
 - 2. Structural Fill:
 - a. May be low volume change cohesive or granular soil at Contractor's option.
 - b. Free of organic matter, frozen material and debris.
 - c. Low volume change cohesive soil:
 - 1) ASTM D2487 classification: CL-ML or CL.
 - 2) Liquid limit: Less than 45.
 - 3) Maximum plasticity index: 20.
 - d. Granular soil:
 - 1) ASTM D2487 classification: GW, GP, SP, or SC.
 - 3. Non-Structural Fill:
 - a. ASTM D2487 classification: SM, CL-ML or CL.
 - b. Liquid limit: Less than 45.
 - c. Maximum plasticity index: 20.
- B. Working Surface:
 - 1. Crushed limestone or other rock approved by Engineer.
 - 2. 1 IN maximum size, dense-graded material.
 - 3. Minimum Proctor density: 120 PCF.
- C. Base Course Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.
- D. Granular Fill Under Building Floor Slabs-On-Grade, Electrical Equipment Pads, Manholes and Handholes:
 - 1. Clean, granular material.
 - 2. Less than 5 PCT fines passing the No. 200 sieve.
 - 3. ASTM C33/C33M gradation size No. 67, 3/4 IN to No. 4 or other material acceptable to Geotechnical Engineer.
 - 4. Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel.
 - 5. 100 PCT passing a 1-1/2 IN sieve.
 - 6. No more than 5 PCT passing a No. 4 sieve.
- E. Granular Fill Under Base Slabs with Pressure Relief Valves:
 - 1. Drainage material: Conform to ASTM C33/C33M, Size No. 67.
 - 2. Filter material: Conform to ASTM C33/C33M requirements for fine aggregate.
- F. Drainage Course: Free draining stone such as #57 stone or #67 stone meeting the requirements of ASTM C33/C33M specifications.
- G. Granular Fill Under Electrical Equipment Pads, Manholes and Handholes: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33/C33M gradation size No. 67, 3/4 IN to No. 4.
- H. Geotextile Filter Fabric:
 - 1. Nonwoven type.
 - 2. Equivalent opening size: 50 - 100 (U.S. Standard Sieve).
 - 3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.
 - 4. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632 requirements.
 - 5. Mullen burst strength: 125 PSI minimum in accordance with ASTM D3786 requirements.
- I. Vapor Retarder: Refer to Specification Section 07 26 00.

- J. Control Low Strength Material (CLSM): See Section 03 31 30.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
 2. Protect and maintain bench marks, monuments or other established reference points and property corners.
 - a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
 3. Verify location of utilities.
 - a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
 - b. Secure and examine local utility records for location data.
 - c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
 - 1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
 - 2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
 - 3) Obtain Owner's approval prior to disconnecting any utility service.
 - d. Repair damages to utility items at own expense.
 - e. 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.
 - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
 - c. 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.

3.2 SITE EXCAVATION AND GRADING

- A. The site excavation and grading work includes the offsite disposition of all material:
1. That exceed quantities required for earthwork on the project.
 2. That the Geotechnical engineer classifies as unclassified excavation.
 3. That the Geotechnical engineer classifies as unacceptable.
 4. That the Geotechnical engineer classifies as potentially contaminated.
- B. Excavation and Grading:
1. Perform as required by the Contract Drawings.
 2. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
 - a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
 - b. Perform other layout work required.

- c. Replace property corner markers to original location if disturbed or destroyed.
 - 3. Preparation of ground surface for embankments or fills:
 - a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
 - b. 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.
 - 4. Protection of finish grade:
 - a. During construction, shape and drain embankment and excavations.
 - b. Maintain ditches and drains to provide drainage at all times.
 - c. Protect graded areas against action of elements prior to acceptance of work.
 - d. Reestablish grade where settlement or erosion occurs.
- C. Borrow:
 - 1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
 - 2. Include cost of all borrow material in original proposal.
 - 3. Fill material to be approved by Geotechnical 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.
 - a. 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.
 - a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
 - b. Do not place material in layers greater than 8 IN loose thickness.
 - c. Place layers horizontally and compact each layer prior to placing additional fill.
 - 3. Compact soils as required to obtain specified density. Selection of appropriate equipment is the Contractor's responsibility.
 - a. In general, compact cohesive soils by sheepsfoot, and granular soils by pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
 - b. Control moisture for each layer necessary to meet requirements of compaction.
- E. Grading Tolerances: As shown on Drawings.

3.3 USE OF EXPLOSIVES

- A. Blasting with any type of explosive is prohibited.

3.4 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from Geotechnical 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 Geotechnical Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by Geotechnical Engineer.
- E. Assure by results of testing that compaction densities comply with the following requirements:
 - 1. Sitework:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Under Paved Areas, Sidewalks and Piping:		
Cohesive soils	95 PCT per ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	75 PCT relative density per ASTM D4253 and ASTM D4254	
Unpaved Areas:		
Cohesive soils	90 PCT of ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	65 PCT relative density per ASTM D4253 and ASTM D4254	

2. Structures:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	95 PCT per ASTM D698	-2 to +3 PCT of optimum
Outside structures next to walls, piers, columns and any other structure exterior member	95 PCT per ASTM D698	-2 to +3 PCT of optimum

3. Specific areas:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Outside structures under equipment support foundations	98 PCT per ASTM D698	-2 to +3 PCT of optimum
Under void	85 PCT per ASTM D1557	-2 to +3 PCT of optimum
Granular fill under base slabs with pressure relief valves	75 PCT relative density per ASTM D4253 and ASTM D4254 or 98 PCT of ASTM D698	
Granular fill under building floor slabs-on-grade	60 PCT relative density per ASTM D4253 and ASTM D4254	

3.5 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:

1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
2. Obtain fill and backfill material necessary to produce grades required.
 - a. Materials and source to be approved by Geotechnical Engineer.
 - b. Excavated material approved by Geotechnical Engineer may also be used for fill and backfill.
3. In the paragraphs of this Specification Section, 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:

- a. Do not commence excavation for foundations for structures until Geotechnical Engineer approves:
 - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
 - 2) Density and moisture content of site area compacted fill material meets requirements of specifications.
 - 3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
 - 4) Surcharge or mass fill material has been removed from construction area or portions thereof.
- b. Engineer grants approval to begin excavations.
2. Dimensions:
 - a. Excavate to elevations and dimensions indicated or specified.
 - b. Allow additional space as required for construction operations and inspection of foundations.
 - c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
 - d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
 - a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Geotechnical Engineer.
 - b. When excavation has reached required subgrade elevations, notify Geotechnical Engineer, who will make an inspection of conditions.
 - 1) If Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide Subgrade Stabilization as specified herein.
4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
 - a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
 - b. 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 Specification Section before fill material can be placed thereon.
 - c. Do not carry excavations lower than shown for foundations except as directed by Geotechnical Engineer or Engineer.
 - d. If any part of excavations is carried below required depth without authorization, notify Engineer and correct unauthorized excavation as directed. Corrections may include:
 - 1) Under soil supported footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
 - a) Concrete fill may be used to bring elevations to proper position.
 - 2) In locations other than those above, including slabs on grade and pile supported foundations, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Geotechnical Engineer.
 - 3) No extra compensation will be made to Contractor for correcting unauthorized excavations.
5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
6. Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.

- a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Geotechnical 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.
 - b. Geotechnical Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
 - c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
 - d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Dewatering:
- a. 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.
 - b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
 - c. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - d. Employ dewatering specialist for selecting and operating dewatering system.
 - e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
 - f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 - 1) Install groundwater monitoring wells as necessary.
 - g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
8. Subgrade stabilization:
- a. 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 Geotechnical Engineer.
 - b. Provide compaction density of replacement material as stated in this Specification Section.
 - c. Loose, wet, or soft materials, when approved by Geotechnical Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
 - d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
 - e. Remove and replace frozen materials as directed by Geotechnical Engineer.
 - f. Method of stabilization shall be performed as directed by Geotechnical Engineer.
 - g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Geotechnical Engineer.
9. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
- a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DEGF before structure is completed and heated to a temperature of at least 50 DEGF.
10. Protection of structures:
- a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.

- b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
11. Shoring:
 - a. Shore, slope, or brace excavations as required to prevent them from collapsing.
 - b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
 - c. Construct shoring that is required to retain water as part of the dewatering system, using non-permeable details such as interlock sealant for sheet piles.
 12. Drainage:
 - a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
 - b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
 - c. Provide pumping required to keep excavated spaces clear of water during construction.
 - d. Should any water be encountered in the excavation, notify Engineer and Geotechnical Engineer.
 - e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
 13. Frost protection:
 - a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
 - b. 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.
 - c. Protect excavation from frost if placing of concrete or fill is delayed.
 - d. 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.
 - e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DEGF.
- C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
1. General:
 - a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Geotechnical Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
 - b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 PCT.
 - c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Geotechnical Engineer as being free of undesirable material and compacted to specified density.
 2. Obtain approval of fill and backfill material and source from Geotechnical Engineer prior to placing the material.
 3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.
 4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 and shown on Contract Drawings.
 5. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Geotechnical Engineer.
 - b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.

- c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
 - d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
 - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum.
 - 2) Contractor is responsible for method of compaction so as not to damage wall.
 - e. Use hand operated equipment for filling and backfilling next to walls.
 - f. Do not place fill and backfill when the temperature is less than 40 DEGF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment to compact granular material; do not use water.
6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified overexcavation to bottom of foundation.

D. Filling and Backfilling Outside of Structures:

- 1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
- 2. Provide material as approved by Geotechnical Engineer for filling and backfilling outside of structures.
- 3. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Geotechnical Engineer.
 - b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
 - c. Compact material with equipment of proper type and size to obtain density specified.
 - d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
 - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum.
 - 2) Contractor is responsible for method of compaction so as not to damage wall.
 - e. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
 - f. Do not place fill or backfill material when temperature is less than 40 DEGF and when subgrade to receive material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment for compacting granular material; do not use water.
- 4. 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.
 - b. 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.
 - c. 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.
 - 1) See Contract Drawings for specific exceptions.
 - d. 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 Specification Section.

2. 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.
3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

3.6 FIELD QUALITY CONTROL

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA Standards, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.
- B. Special Inspection and Testing:
 1. See Section 01 45 33.
- C. Responsibilities of Special Inspector:
 1. Review proposed materials for fill and backfill around structures.
 2. Services will include documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
 3. Moisture density relations, to be established by the testing firm required for all materials to be compacted.
 4. Extent of compaction testing will be as necessary to assure compliance with specifications.
 5. Make at least one field density test on subgrade and each compacted fill layer for every 2000 SQFT.
 6. Prepare and submit inspection and test reports to Engineer.
 - a. Coordinate such work with other Special Inspectors.
 7. Test reports to include the following:
 - a. Report and certification of aggregate fill and drainage fill.
 - b. Test reports on borrow material.
 - c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - d. Field reports; in-place soil density and moisture tests.
 - e. One optimum moisture-maximum density curve for each type of soil encountered.
 - f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
 - g. Other documentation necessary for Geotechnical Engineer to approve earthwork.
 - h. Assist Engineer to determine corrective measures necessary for defective work.
- D. Should any compaction density test or subgrade inspection fail to meet specification requirements, perform corrective work as necessary, at no additional expense to Owner.
- E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.
- F. Responsibilities of Testing Agency for Site Excavation and Grading:
 1. All testing, observation and work indicated as being performed by the testing firm.
 2. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
 3. Moisture density relations, to be established by the testing firm required for all materials to be compacted.
 4. Extent of compaction testing will be as necessary to assure compliance with specifications.

END OF SECTION

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SECTION 31 23 10
EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Earthwork - excavation, backfilling, compaction, disposal of waste and surplus materials, placing structural fill, placing crushed stone, sheeting, bracing, dewatering and other Earthwork related work.
- B. Related Specification Sections include but are not necessarily limited to:
1. Section 07 26 00 - Under Slab Vapor Retarder.
 2. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. ASTM International (ASTM):
 - a. C33, Standard Specification for Concrete Aggregates.
 - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 feet-LBF/CUFT).
 - c. D1241, Standard Specification for Material for Soil-Aggregate Subbase, Base, and Surface Courses.
 - d. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 feet-LBF/CUFT(2,700 kN-M/M)).
 - e. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - f. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
 - g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - h. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - i. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 2. American Association of State Highway and Transportation Officials (AASHTO)
 - a. M 43, Standard Specification for Sizes of Aggregate for Road and Bridge Construction.
 - b. M 57, Standard Specification for Materials for Embankment and Subgrades.
 - c. M 147, Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.
- B. Federal Regulations:
1. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926.650, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

1.3 DEFINITIONS

- A. Excavation:
1. Consists of removal of material encountered to subgrade elevations required or indicated.
 2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.
- B. Foundations: Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.

- C. Geotechnical Engineer: Independent geotechnical specialist providing field quality control for the project.
- D. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving, or other flatwork.
- E. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.
- F. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.
- G. Unauthorized Excavation:
 - 1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
 - a. Unauthorized excavation, as well as associated remedial work as directed by Engineer or Geotechnical Engineer, shall be at Contractor's expense.
 - 2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Geotechnical Engineer.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Plans and elevations showing location and dimension of components.
 - 2. Details of connections, design elements, and relation to adjacent items.
- B. Product Data:
 - 1. Acknowledgement that products submitted meet requirements of standards referenced.
 - 2. Manufacturer's installation instructions.
 - 3. Certifications.
 - 4. Excavation Support System:
 - a. Submit prior to the installation of excavation support system the following:
 - 1) Supporting calculations sealed by a Professional Engineer licensed in the State of Idaho.
 - 2) Detail drawings sealed by a Professional Engineer licensed in the State of Idaho, showing type and location of support system.
- C. Samples:
 - 1. Coordinate samples and testing for approval of off-site materials with the Geotechnical Engineer.

1.5 PROJECT CONDITIONS

- A. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.
- B. Dispose of waste materials, legally, off site.
 - 1. Burning, as a means of waste disposal, is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill and Backfill:
 - 1. Selected material approved by Geotechnical Engineer from off site borrow.
 - 2. Structural Fill:
 - a. May be low volume change cohesive or granular soil at Contractor's option.
 - b. Free of organic matter, frozen material and debris.
 - c. Low volume change cohesive soil:
 - 1) ASTM D2487 classification: CL-ML or CL.

- 2) Liquid limit: Less than 45.
- 3) Maximum plasticity index: 20.
- d. Granular soil:
 - 1) ASTM D2487 classification: GW, GP, GM, GC, SW, SP, SM or SC.
- 3. Non-Structural Fill:
 - a. ASTM D2487 classification: GW, GP, GM, GC, SC, SW, SP, SM, CL-ML or CL.
 - b. Liquid limit: Less than 45.
 - c. Maximum plasticity index: 20.
- B. Granular Fill Under Building Floor Slabs-On-Grade:
 - 1. Clean, granular material.
 - 2. Less than 5% fines passing the No. 200 sieve.
 - 3. ASTM C33/AASHTO M43 gradation size No. 89, 3/8 inches to No. 4 or other material acceptable to Geotechnical Engineer.
- C. Granular Fill Under Spread Footing Foundations and Mat Foundations:
 - 1. Clean, Granular material.
 - 2. Less than 5% fines passing the No. 200 sieve.
 - 3. ASTM D1241/AASHTO M147 Grading "B" or other material acceptable to Geotechnical Engineer.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Erosion Control:
 - 1. Clean paved roadways daily of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
 - 2. Conduct work to minimize erosion of site. Remove eroded material washed off site.
 - a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.
- B. Protect existing surface and subsurface features on-site and adjacent to site as follows:
 - 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
 - 2. Protect and maintain bench marks, monuments or other established reference points and property corners.
 - a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
 - 3. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
 - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
 - c. All repairs to be made and paid for by Contractor.
 - 4. 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.
 - 5. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
 - 6. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

3.2 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

- A. General:

1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
 2. Obtain fill and backfill material necessary to produce grades required.
 - a. Materials and source to be approved by Geotechnical Engineer.
 - b. Excavated material approved by Geotechnical Engineer may also be used for fill and backfill.
 3. In the paragraphs of this Specification Section, 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:
 - a. Do not commence excavation for foundations for structures until Geotechnical Engineer approves:
 - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
 - 2) Density and moisture content of site area compacted fill material meets requirements of specifications.
 - 3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
 - 4) Surcharge or mass fill material has been removed from construction area or portions thereof.
 - b. Engineer grants approval to begin excavations.
 2. Dimensions:
 - a. Excavate to elevations and dimensions indicated or specified.
 - b. Allow additional space as required for construction operations and inspection of foundations.
 - c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
 - d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
 3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
 - a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Geotechnical Engineer.
 - b. Remove unsuitable subgrade soils located below foundations. The bottom of the overexcavation shall be located outside the exterior limits of foundations around the perimeter of structure the following horizontal distance, whichever is greater:
 - 1) Distance equal to depth of overexcavation below bottom of foundations.
 - 2) 5 feet.
 - 3) As directed by Geotechnical Engineer.
 - c. When excavation has reached required subgrade elevations, notify Geotechnical Engineer, who will make an inspection of conditions.
 - 1) If Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide Subgrade Stabilization as specified herein.
 4. Install working surface over approved subgrade.
 - a. Minimum thickness: 12 inches.
 5. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
 - a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
 - b. 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 inches and then compact to density stated in this Specification Section before fill material can be placed thereon.
- c. Do not carry excavations lower than shown for foundations except as directed by Geotechnical Engineer or Engineer.
 - d. If any part of excavations is carried below required depth without authorization, notify Engineer and correct unauthorized excavation as directed. Corrections may include:
 - 1) Under soil supported footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
 - a) Concrete fill may be used to bring elevations to proper position.
 - 2) In locations other than those above, including slabs on grade and pile supported foundations, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Geotechnical Engineer.
 - 3) No extra compensation will be made to Contractor for correcting unauthorized excavations.
6. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
 7. Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.
 - a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Geotechnical 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.
 - b. Geotechnical Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
 - c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
 - d. 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.
 8. Subgrade stabilization:
 - a. 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 Geotechnical Engineer.
 - b. Provide compaction density of replacement material as stated in this Specification Section.
 - c. Loose, wet, or soft materials, when approved by Geotechnical Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
 - d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
 - e. Remove and replace frozen materials as directed by Geotechnical Engineer.
 - f. Method of stabilization shall be performed as directed by Geotechnical Engineer.
 - g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Geotechnical Engineer.
 9. Protection of structures:
 - a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.

- b. 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.
10. Shoring:
- a. Shore, slope, or brace excavations as required to prevent them from collapsing.
 - b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
 - c. Construct shoring that is required to retain water as part of the dewatering system, using non-permeable details such as interlock sealant for sheet piles.
11. Drainage:
- a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
 - b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
 - c. Provide pumping required to keep excavated spaces clear of water during construction.
 - d. Should any water be encountered in the excavation, notify Engineer and Geotechnical Engineer.
 - e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
12. Frost protection:
- a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
 - b. 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.
 - c. Protect excavation from frost if placing of concrete or fill is delayed.
 - d. 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.
 - e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 degrees F.
- C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
1. General:
- a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Geotechnical Engineer and scarified to a depth of 6 inches and compacted to density specified herein.
 - b. Surface may be stepped by at not more than 12 inches per step or may be sloped at not more than 2%.
 - c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Geotechnical Engineer as being free of undesirable material and compacted to specified density.
2. Obtain approval of fill and backfill material and source from Geotechnical Engineer prior to placing the material.
3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.
4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 and shown on Contract Drawings.
5. Fill and backfill placement:
- a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Geotechnical Engineer.
 - b. Place fill and backfill material in 8 inches lifts.

- c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
 - d. Use hand operated equipment for filling and backfilling within 5 feet of walls and less than 3 feet above pipes.
 - 1) Compaction equipment exceeding 3,000 pounds dead weight shall not be used within 5 feet of the wall as a minimum.
 - 2) Contractor is responsible for method of compaction so as not to damage walls or buried commodities.
 - e. Use hand operated equipment for filling and backfilling next to walls.
 - f. Do not place fill and backfill when the temperature is less than 40 degrees F and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment to compact granular material; do not use water.
6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified overexcavation to bottom of foundation.
- D. Filling and Backfilling Outside of Structures.
- 1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
 - 2. Provide material as approved by Geotechnical Engineer for filling and backfilling outside of structures.
 - 3. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Geotechnical Engineer.
 - b. Place fill and backfill material to maximum allowable lift thickness indicated in Paragraph 3.2, C, 5, b of this Section.
 - c. Compact material with equipment of proper type and size to obtain density specified.
 - d. Use hand operated equipment for filling and backfilling within 5 feet of walls and less than 3 feet above pipes.
 - 1) Compaction equipment exceeding 3,000 pounds dead weight shall not be used within 5 feet of the wall as a minimum.
 - 2) Contractor is responsible for method of compaction so as not to damage walls or buried commodities.
 - e. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
 - f. Do not place fill or backfill material when temperature is less than 40 degrees F and when subgrade to receive material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment for compacting granular material; do not use water.
 - 4. 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.
 - b. 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.
 - c. 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.
 - 1) See Contract Drawings for specific exceptions.
 - d. 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 Specification Section.

2. 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.
3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

3.3 USE OF EXPLOSIVES

- A. Blasting with any type of explosive is prohibited.

3.4 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from Geotechnical 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 Geotechnical Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by Geotechnical Engineer.
- E. Assure by results of testing that compaction densities comply with the following requirements:
 1. Structures:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	98% per ASTM D698	-2 to +3% of optimum
Outside structures next to walls, piers, columns and any other structure exterior member	92% per ASTM D698	-2 to +3% of optimum

2. Specific areas:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Outside structures under equipment support foundations	98% per ASTM D698	-2 to +3% of optimum
Under void	85% per ASTM D1557	-2 to +3% of optimum

3.5 FIELD QUALITY CONTROL

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA standards 29 CFR Part 1926.650 Subpart P, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.
- B. Special Inspection and testing:
 1. See Section 01 45 33.
- C. Responsibilities of Special Inspector:
 1. Review proposed materials for fill and backfill around structures.
 2. All testing, observation and work indicated as being performed by the Geotechnical Engineer in Article 3.5 of this Specification Section.

3. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
 4. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
 5. Extent of compaction testing will be as necessary to assure compliance with specifications.
 6. Prepare and submit inspection and test reports to Engineer.
 - a. Coordinate such work with other Special Inspectors.
 7. Test reports to include the following:
 - a. Report and certification of aggregate fill and drainage fill.
 - b. Test reports on borrow material.
 - c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - d. Field reports; in-place soil density and moisture tests.
 - e. One optimum moisture-maximum density curve for each type of soil encountered.
 - f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
 - g. Other documentation necessary for Geotechnical Engineer to approve earthwork.
 - h. Assist Engineer to determine corrective measures necessary for defective work.
- D. Responsibilities of Testing Agency for Excavation and Backfilling:
1. All testing, observation and work indicated as being performed by the Geotechnical Engineer in other than Article 3.5 of this Specification Section.
 2. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
 3. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
 4. Extent of compaction testing will be as necessary to assure compliance with specifications.

END OF SECTION

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SECTION 31 23 33
TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, trenching, backfilling and compacting for all underground utilities.
 - 2. Process piping.
 - 3. Relocation of existing piping.
 - 4. Electrical ductbanks, conduits, and direct burial cables.
 - 5. All related utility and process appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 2. Division 26 - Electrical.
 - 3. Section 31 23 00 - Earthwork.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 feet-LBF/FT³ (600 kN-M/M³)).
 - b. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - c. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- B. Qualifications: Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

1.3 DEFINITIONS

- A. Excavation: All excavation will be defined as unclassified.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 2. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
 - 3. Submit sieve analysis reports on all granular materials.
- B. Informational Submittals:
 - 1. Trench shield (trench box) certification if employed:
 - a. Specific to Project conditions.
 - b. Re-certified if members become distressed.
 - c. Certification by registered professional structural engineer, registered in the state where the Project is located.
 - d. Engineer is not responsible to, and will not, review and approve.

1.5 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.

1. 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.

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: $\pm 3\%$ of optimum moisture content as specified in accordance with ASTM D698.
2. Gravel trench backfill materials:
 - a. Uniformly graded pea gravel defined below:

Sieve Size	1 inches	3/4 inches	3/8 inches	No. 4	No. 20
Percent Passing by Weight	100	100	93	11	1

B. Subgrade Stabilization Materials: Provide subgrade stabilization material consisting of 1 inch minus.

C. Bedding Materials:

1. As approved by the Geotechnical Engineer.
2. Granular bedding materials:
 - a. ASTM C33/C33M, gradation 67 (3/4 inches to No. 4 sieve) defined below:

Sieve Size	1 inches	3/4 inches	3/8 inches	No. 4	No. 20
Percent Passing by Weight	100	90-100	20-55	0-10	0

- 1) Well-graded crushed stone.
- 2) Well graded crushed gravel.
- 3) Well graded gravel.
3. Flowable fill:
 - a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
 - b. Material characteristics:
 - 1) The approximate quantities of each component per cubic yard of mixed material shall be as follows:
 - a) Cement (Type I or II): 50 pounds.
 - b) Fly ash: 200 pounds.
 - c) Fine sand: 2,700 pounds.
 - d) Water: 420 pounds.
 - e) Air content: 10%.
 - 2) Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
 - 3) Approximate compressive strength should be 85 to 175 psi.

- 4) Fine sand shall be an evenly graded material having not less than 95% passing the No. 4 sieve and not more than 5% passing the No. 200 sieve.
- 5) Mixing and handling of the material shall be in accordance with Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove and dispose of unsuitable materials as directed by Geotechnical Engineer to site provided by Contractor.

3.2 EXCAVATION

- A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Geotechnical Engineer.
- B. Excavation for Appurtenances:
 1. 12 inches (minimum) clear distance between outer surface and embankment.
 2. See Specification Section 31 23 00 for applicable requirements.
- C. Groundwater Dewatering:
 1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
 2. Groundwater shall be drawn down and maintained at least 3 feet below the bottom of any trench or manhole excavation prior to excavation.
 3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - a. Employ dewatering specialist for selecting and operating dewatering system.
 4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
 5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 6. Install groundwater monitoring wells as necessary.
 7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
 8. Cost of groundwater dewatering shall be compensated under an allowance.
- D. Trench Excavation:
 1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
 - a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
 - 1) Stabilize excavation to prevent undermining of existing utility and yard piping.
 2. Open trench outside buildings, units, and structures:
 - a. No more than the distance between two manholes, structures, units, or 300 LF, whichever is less.
 - b. Field adjust limitations as weather conditions dictate.
 3. Trenching within buildings, units, or structures:
 - a. No more than 100 LF at any one time.
 4. Any trench or portion of trench, which is opened and remains idle for seven calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
 - a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
 5. Observe following trenching criteria:

- a. Trench size:
 - 1) Excavate width to accommodate free working space.
 - 2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 inches and less	18 inches
more than 33 inches	24 inches

- 3) Cut trench walls vertically from bottom of trench to 1 foot above top of pipe, conduit, or utility service.
- 4) Keep trenches free of surface water runoff.
 - a) Include cost in Bid.
 - b) No separate payment for surface water runoff pumping will be made.

E. Trenching for Electrical Installations:

- 1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
- 2. Modify for electrical installations as follows:
 - a. Open no more than 600 linear foot of trench in exterior locations for trenches more than 12 inches but not more than 30 inches wide.
 - b. Any length of trench may be opened in exterior locations for trenches which are 12 inches wide or less.
 - c. Do not over excavate trench.
 - d. Cut trenches for electrical runs with minimum 30 inches cover, unless otherwise specified or shown on Drawings.
 - e. See Division 26 for additional requirements.

F. Flowable Fill:

- 1. Flowable fill shall be:
 - a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
 - b. Placed in 4 feet maximum lifts to the elevations indicated.
 - 1) Allow 12 hour set-up time before placing next lift or as approved by the Engineer.
 - 2) Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
- 2. Flowable fill shall not be placed on frozen ground.
- 3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
- 4. Conform to appropriate requirements of Specification Section 31 23 00.
- 5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 degrees F and rising.
- 6. At the time of placement, flowable fill must have a temperature of at least 40 degrees F.
- 7. Mixing and placing shall stop when the air temperature is 38 degrees F or less and falling.
- 8. Each filling stage shall be as continuous an operation as is practicable.
- 9. Prevent traffic contact with flowable fill for at least 24 hours after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
- 10. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of the preceding Groundwater Dewatering paragraph in PART 3 of this Specification Section.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:

- 1. Backfill and compact to 90% of maximum dry density per ASTM D698.
- 2. Backfill with granular bedding material as option.

- B. Rock Excavation:
 1. Excavate minimum of 6 inches 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 with specified requirements.
- B. Carefully Compacted Backfill:
 1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 inches above top of pipe or conduit.
 2. Comply with the following:
 - a. Place backfill in lifts not exceeding 8 inches (loose thickness).
 - b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
 - c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
 - d. Compact each lift to specified requirements.
- C. Common Trench Backfill:
 1. Perform in accordance with the following:
 - a. Place backfill in lift thicknesses capable of being compacted to densities specified.
 - b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
 - c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.
- D. Water flushing for consolidation is not permitted.
- E. Backfilling for Electrical Installations:
 1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill paragraph in PART 3 of this Specification Section or when approved by the Engineer.
 2. Modify for electrical installation as follows:
 - a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.5 COMPACTION

- A. General:
 1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
 2. In no case shall degree of compaction below minimum compactions specified be accepted.
- B. Compaction Requirements:
 1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.
 - a. Bedding material:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

b. Carefully compacted backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All applicable areas	Cohesive soils	95% of maximum dry density by ASTM D698
	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

c. Toe drain bedding and backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	60% relative density by ASTM D4253 and ASTM D4254

d. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	95% of maximum dry density by ASTM D698
	Cohesionless soils	60% of relative density by ASTM D4253 and ASTM D4254
Under turf, sodded, plant seeded, nontraffic areas	Cohesive soils	85% of maximum dry density by ATM D698
	Cohesionless soils	40% of relative density by ASTM D4253 and ASTM D4254

3.6 FIELD QUALITY CONTROL

A. Testing:

1. Perform in-place moisture-density tests as directed by the Owner.
2. Perform tests through recognized testing laboratory approved by Owner.
3. Costs of "Passing" tests paid by Owner.
4. Perform additional tests as directed until compaction meets or exceeds requirements.
5. Cost associated with "Failing" tests shall be paid by Contractor.
6. Reference to Engineer in this Specification Section will imply Geotechnical Engineer when employed by Owner and directed by Engineer to undertake necessary inspections as approvals as necessary.
7. Assure Owner has immediate access for testing of all soils related work.
8. Ensure excavations are safe for testing personnel.

END OF SECTION



DIVISION 32

EXTERIOR IMPROVEMENTS



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SECTION 32 12 16
ASPHALTIC CONCRETE VEHICULAR PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Asphaltic concrete vehicular paving.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. 2017 Idaho Standards for Public Works Construction (ISPWC) Division 800 – Aggregates and Asphalt

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Idaho Standards for Public Works Construction Section 800 Aggregates and Asphalt
 - 2. AASHTO Standard Specifications for Transportation and Methods of Sampling and Testing.
 - 3. WAQTC – Western Alliance for Quality Transportation Construction.
- B. Test Methods
 - 1. Particle size distribution of aggregates – AASHTO T 27
 - 2. Mechanical Analysis of Extracted Aggregate – AASHTO T 30
 - 3. Marshall – AASHTO T 245
 - 4. Percent of Crushed Particles – AASHTO TP 61
 - 5. Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt Paving Mixtures – AASHTO T 209
 - 6. Bulk Specific Gravity of Compacted Bituminous Mixtures – AASHTO T 166 and T 275
 - 7. Percentage of Coated particles in Bituminous Mixtures – Idaho T 96
 - 8. Nuclear method for Determination of the Density of an Asphalt Pavement – Idaho WAQTC TM-8
 - 9. Quantitative Extraction of Bitumen from Bituminous Paving Mixtures – AASHTO T 164
 - 10. Standard Practice for Operating Inertial Profilers and Evaluating Pavement Profiles – AASHTO PP-50
 - 11. Sampling Bituminous Paving Mixture – AASHTO T 168
 - 12. Plastic Fines in Graded Aggregate and Soils by Use of the Sand Equivalent Test – AASHTO T 176
 - 13. Determining the asphalt binder content of hot mix asphalt (HMA) by the ignition method – AASHTO T 308
 - 14. Reducing Samples of Aggregate to Testing Size – AASHTO T 248
 - 15. Moisture Content of Bituminous Mixes by Oven – WAQTC TM - 6
- C. Construction standards:
 - 1. State of Idaho, Idaho Standards for Public Works Construction (ISPWC), as amended to date.

1.3 SUBMITTALS

- A. Mix Design:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:

- a. Job mix formula (JMF) stamped by an engineer licensed in the State of Idaho for HMA pavement that complies with the Marshall mix requirements outlined in this specification.
- b. JMF design and applicable aggregate tests performed by qualified independent laboratories.
- c. Gradation test reports and applicable fracture count reports for all material in stockpiles.
- d. JMF design test reports whenever new stockpiles are made which have gradations that are not possible to blend to the overall gradation of the existing JMF design.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot Mix Asphalt Design

- 1. ½ inch Marshall Method Design Criteria:

TABLE 1

Parameter	Value
Number of compaction blows, each end of specimen	50
Stability, minimum	1,200
Flow	8 - 18
Air Voids, percent	3 - 5

- 2. Provide virgin aggregate for all mixes in a minimum of two separate stockpiles.
- 3. All HMA designs shall use a minimum one-half percent approved liquid anti-stripping additive by weight of asphalt. Lime may be used as the anti-stripping additive, if it was included in the job mix design.

B. Aggregates

- 1. Mixes to meet ½ inch requirements of ISPWC Section 803 – Plant Mix Aggregates.
- 2. Aggregate quality will be controlled at the hot plant.
 - a. Conduct sampling and testing at hot plant to assure a uniform combined aggregate gradation is maintained. Aggregate gradation, sand equivalency, and fractured faces will be performed on cold feed samples as needed to control the operation but at least 1 test per each 1500 tons of plant mix produced.
 - b. Variation from the as crushed, combined stockpile average not to exceed ±4% on the No. 4 sieve and ±2% on the No. 200 sieve for samples from the combined aggregate feed.

C. Asphalt

- 1. Material to meet requirements of ISPWC Section 805 – Asphalt.
 - a. Asphalt to be of the type and grade called for.
 - b. Asphalt will be accepted at point of delivery.
- 2. All asphalt shall be furnished by one (1) supplier. If a change of liquid asphalt supplier is proposed, mix design testing and verification are required as conditions of approval.

D. Anti-Stripping Additive

- 1. Anti-Strip additive will be accepted at point of delivery.

PART 3 - EXECUTION

3.1 MIXING PLANT

- A. The mixing plant shall be a commercially manufactured plant capable of producing a uniform mixture and conforming to the following requirements.
- B. Dryer
 - 1. Plant to be equipped with dryer or dryers that continuously agitate the aggregates during the heating process.
- C. Asphalt control Unit
 - 1. Provide satisfactory means of weighting or metering for obtaining and checking the amount of asphalt in the mix.
 - 2. Asphalt control unit to be interconnected with the aggregate feed control and be capable of delivering asphalt to the mix within $\pm 2\%$ of the intended quantity throughout the range of plant operation.
- D. Sampling Devices
 - 1. Equip plant with adequate sampling devices on cold feed.
 - a. Sampling device to be operable from the ground or a platform.
 - b. Sampling device to move at a constant rate across the full width of the falling column of material from the discharge belt or chute.
 - c. Equipment to achieve a representative sample, conveyed to the ground by means of a slide, chute or other means where the sampled material can be safely and conveniently collected.

3.2 HAULING EQUIPMENT

- A. Trucks used for hauling plant mix to have tight, clean, smooth, metal beds.
- B. All trucks to be equipped with suitable covers to protect the mixture from adverse weather or long hauls.
- C. Do not use fuel oil or other petroleum-based oil as a release agent.

3.3 PAVER

- A. Paver to be self-propelled with an activated heated screed.
- B. All screed extensions to be activated and heated except for shoulder widening not exceeding 1 foot.
- C. Extended screeds to be equipped with corresponding auger and tunnel extensions to ensure a uniform head of fresh material across the entire screed.
- D. Screed to be equipped with automatic controls capable of adjustments in both transverse and longitudinal directions.
- E. Sensing device to be adaptable to picking up grade from a string line, rail or ski.
- F. Maintain to the extent possible, a continuous, non-stopped paving operation.
- G. Do not use fuel or other petroleum-based oil as a release agent.

3.4 ROLLERS

- A. Rollers to be of the steel wheel, vibratory or pneumatic tire type in good condition and capable of reversing direction.
- B. Provide sufficient number of capacitive force rollers to achieve compaction as required for acceptance.
- C. Equipment which produces excessive crushing of the aggregate is not allowed.

- D. Roller producing pickup, washboard, uneven compaction of the surface or other undesirable results are not allowed.
- E. Roller requirements
 - 1. Vibratory Rollers
 - a. Variable amplitude with at least two settings
 - b. Variable frequency with minimum of 200 VPM
 - c. Maximum rate of travel under vibration to be 2.5 mph – 220 feet/minute
 - d. Vibratory rollers with pneumatic tired drive wheels to have smooth tires that leave no visible tracks
 - 2. Pneumatic Tired Rollers
 - a. Maximum rate of travel to be 5 mph
 - b. Rollers to be equipped with smooth compactor tires
- F. Do not use fuel or other petroleum based oil as a release agent

3.5 MIXING

- A. Moisture content of mixture at the time of placement not to exceed 1%
- B. Mixing temperature shall comply with the Viscosity-Temperature chart and be for the same type and source as the asphalt cement supplied to the project

3.6 SPREADING AND FINISHING

- A. Surface must be approved prior to placing mixture.
- B. Place pavement in lifts as required in the contract documents. Minimum ratio of lift thickness to nominal maximum aggregate size (tNMA) is 3 unless otherwise approved.
- C. Apply a thin, uniform asphalt tack coat to the surfaces of curbing, gutters, manholes, asphalt cement pavement, Portland cement pavement, and other structure pavement will abut.
- D. Paver to be equipped with a 24 inch wide slope shoe.

3.7 JOINTS

- A. A joint is considered a cold joint when the surface temperature of the previously laid material has cooled to 175°F or less.
- B. Test all joints for smoothness.
 - 1. Furnish and use an approved 10-foot straight edge for checking joint smoothness.
 - 2. Perform test and make necessary corrections before material drops below 185°F.
- C. Do not allow rollers to pass over the unprotected edge of freshly laid mixes.
- D. Cut back on previous run to expose a vertical edge, full depth of the course for transverse joints.
- E. Apply an asphalt tack coat on contact surfaces of transverse and cold longitudinal joints just before mixture is placed against previously laid or existing material. CSS-1 emulsified asphalt at 0.05 gallons per SY.
- F. Provide positive bond, density and finished surface at longitudinal joints equal in all respects to the mixture against which it is placed.

3.8 WEATHER LIMITATIONS

- A. Do not place plant mix when weather or surface conditions otherwise prevent the proper handling or finishing of the plant mix material.
- B. Conform to the following minimum temperatures for all plant mix pavement operations. Place plant mix only when the air and surface temperature are in accordance with Table 2.

TABLE 2

MINIMUM AIR AND SURFACE TEMPERATURE		
Compacted Thickness of each course	Top Course	Leveling and Courses Below Top Course
Less than 0.1 foot	60°F	50°F
0.1 foot to 0.18 foot	50°F	40°F
Over 0.18 foot	40°F	40°F

- C. Do not start plant mix removal or otherwise alter the surface of existing plant mix unless the progress schedule realistically shows that the pavement can be replaced or completed.

3.9 COMPACTION

- A. Do not operate vibratory rollers in vibratory mode when checking or cracking of the mat occurs.
- B. When rollers are not operating, park off of new mat, shut off vibrator when roller is not in compactive position.
- C. Use the same type, weight rolling equipment and operate at the same VPMs for production paving as was established at the beginning of the operation, unless otherwise approved.
- D. Prevent adhesion of mixture to compaction equipment. Do not use diesel fuel, kerosene or other solvents.
- E. Remove all of the mixture from the gutter surface prior to rolling. Protect adjoining concrete from damage. Repair all damage to concrete caused by Contractor’s operation at the Contractor’s expense.

3.10 FIELD QUALITY ACCEPTANCE

- A. Obtain one sample from the mix being produced per 750 tons or fraction thereof. Minimum of one test per day. Test samples for asphalt cement content per AASHTO T 308 and gradation per AASHTO T 30. Test results must meet the requirements designated in Table 3.

TABLE 3

Parameter	Value
Asphalt Cement Content	± 0.4%
Passing 3/8" Sieve	± 7%
Passing No. 8 Sieve	± 5%
Passing No. 200 Sieve	± 2%

- B. Compact pavement to the percentage range of the AASHTO T 209 theoretical maximum density value as outlined in 1 or 2 below.
 - 1. 91.0 to 96.0 percent for in-place density values determined by WAQTC TM 8. Nuclear densometers must be correlated to cores tested in accordance with AASHTO T 166 at a frequency of one core for every 5 density tests performed, but not less than 3 cores per project. Density testing shall be performed randomly at a frequency of one test per 100 linear feet of pavement.
 - 2. 92.0 to 95.0 percent for in-place density values determined from cores tested in accordance with AASHTO T 166. Density testing shall be performed randomly at a frequency of one test per 300 linear feet of pavement.
- C. In-Place density tests shall be performed a minimum distance of 12 inches from joints.

- D. Furnish new JMF design if results indicate difficulty in meeting existing JMF design requirements.

3.11 SURFACE SMOOTHNESS

- A. Perform straight edge surface smoothness tests no later than the next working day following placement. Provide test results to contracting agency within one working day after testing. If corrective action is necessary, do not continue paving until corrective action has been taken.
 - 1. Straight edge to be an approved device 10 feet in length.
 - 2. Perform straight edge test in areas to be determined and randomly.
 - 3. When straight edge is laid on the surface in a direction parallel or perpendicular to paving lane, surface variation shall not exceed 0.25 inches from the lower edge of the length of the straight edge.
 - 4. Remove any highpoints found by grinding and add fog coat per ISPWC Section 813, at Contractor's expense.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete pavement.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Testing.
 - 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752).
 - b. M171, Standard Specification for Sheet Materials for Curing Concrete (ASTM C1271).
 - c. M182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
 - d. M213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) (ASTM D1751).
 - e. M224, Standard Specification for Use of Protective Sealers for Portland Cement Concrete.
 - f. M233, Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
 - 2. American Concrete Institute (ACI):
 - a. 305R, Guide to Hot Weather Concreting.
 - b. 306R, Guide to Cold Weather Concreting.
 - 3. ASTM International (ASTM):
 - a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. A1064/A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - c. C33/C33M, Standard Specification for Concrete Aggregates.
 - d. C150/C150M, Standard Specification for Portland Cement.
 - e. C174/C174M, Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
 - f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³ (600 kN-M/M³)).
 - h. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - i. D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - j. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

- k. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- 4. Federal Specification (FS):
 - a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements (Withdrawn with no replacement).
 - b. Concrete installer shall have successfully completed at least three other projects of similar size and type.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
 - 4. Qualifications of concrete installer.
 - 5. Drawings detailing all reinforcing.
 - 6. Scaled cross section detail of crown template with dimensions showing off sets from level line.
 - 7. Concrete pavement joint pattern for paved areas.
 - 8. Test reports:
 - a. Concrete cylinder test results from field quality control.
- B. Samples:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II.
- B. Aggregates:
 - 1. ASTM C33/C33M, gradation size #67, 3/4 IN to #4.
 - 2. Clean, crushed gravel.
- C. Water: Potable quality.
- D. Admixtures: Comply with Specification Section 03 31 30.
- E. Reinforcing Bars: ASTM A615/A615M, Grade 60.
- F. Welded Wire Reinforcement:
 - 1. ASTM A1064/A1064M.
 - 2. Flat.
 - 3. Clean, free from dirt, scale, rust.
- G. Preformed Joint Filler:
 - 1. Non-extruding cork, self-expanding cork, sponge rubber or cork rubber.
 - 2. AASHTO M153 or AASHTO M213.
- H. Hot-Poured Joint Sealing Material:
 - 1. FS SS-S-1614.
- I. Membrane Curing Compound: ASTM C309.

- J. Cover Materials for Curing:
 - 1. Burlap:
 - a. AASHTO M182.
 - b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 - 2. Polyethylene film, AASHTO M171.
- K. Paper Subgrade Cover: Polyethylene film, AASHTO M171.
- L. Concrete Treatment:
 - 1. Boiled linseed oil mixture.
 - 2. AASHTO M233.
- M. Forms:
 - 1. Steel or wood.
 - 2. Size and strength to resist movement during concrete placement and able to retain horizontal and vertical alignment.
 - 3. Free of distortion and defects.
 - 4. Full depth.
 - 5. Metal side forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1,700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.2 MIXES

- A. Mix design to provide 4,000 PSI 28-day compressive strength, 4 IN slump, 6 ±1 PCT air.
- B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Preparation:
 - 1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 - 2. Scarify and recompact top 12 IN of fills and embankments which will be under paved areas.
 - 3. Remove soft or spongy areas.
 - a. Replace with structural backfill.
 - b. Coordinate with Geotechnical Engineer.
 - 4. Compact to the following densities:
 - a. Cohesive soils: 95 PCT per ASTM D698.
 - 5. Assure moisture content is within limits prescribed to achieve required compaction density.
 - 6. Following compaction, trim and roll to exact cross section.
 - a. Check with approved grading template.
 - 7. Perform density tests on subgrade to determine that subgrade complies with the specification.
 - 8. Coordinate aggregate course with Structural Engineer and Soils/Geotechnical Engineer.
- B. Aggregate Course:
 - 1. Place material in not more than 6 IN thick layers.
 - 2. Spread, shape, and compact all material deposited on the subgrade during the same day.
 - 3. Compact to 95 PCT relative per ASTM D4253 and ASTM D4254.
- C. Loose and Foreign Material: Remove loose and foreign material immediately before application of paving.

- D. Appurtenance Preparation:
1. Block out or box out curb inlets and curb returns.
 2. Provide for joint construction as detailed and dimensioned on Drawings.
 3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
 - a. Secure to elevation with concrete.
 - b. Place concrete up to 5 IN below design grade.
 4. Headers:
 - a. Construct at open ends of pavements.
 - b. Use same concrete to construct headers as that used in the abutting structure.
 - c. Extend header full width of pavement and crown same as pavement.
 5. Clean and oil forms.

3.2 INSTALLATION

- A. Concrete Production: Comply with Specification Section 03 31 31.
- B. Forms:
1. Form support:
 - a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
 - b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - c. Do not use earth pedestals.
 2. Staking forms:
 - a. Joint forms neatly and tightly.
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 3. Clean and oil forms prior to placement of concrete.
 4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
 5. Previously finished concrete pavement, curb or sidewalk contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
1. Locate longitudinal edge bars between 3 and 6 IN from edge of slab.
 2. Lap mats one full space.
 3. Tie end transverse member of upper mat securely to prevent curving.
 4. Lap nonwelded bars 12 IN minimum.
 5. Support:
 - a. Place bars and heavy mats securely on chairs at called-for height.
 - b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.
- D. Joints:
1. Hold joint location and alignment to within +1/4 IN.
 2. Finish concrete surface adjacent to previously placed slab to within +1/8 IN, with tooled radius of 1/4 IN.
 3. Metal keyway joints:
 - a. Form by installing metal joint strip left in place.
 - b. Stake and support like side form.
 - c. Provide dowels or tie bars.
 4. Weakened plane joints:
 - a. Tooled joints:
 - 1) Form groove in freshly placed concrete with tooling device.
 - 2) Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 - b. Sawed joints:
 - 1) Saw 1/4 IN groove in green concrete.
 - 2) Commence sawing as soon as concrete is hard enough to withstand operation without chipping, spalling or tearing, regardless of nighttime or weather.

- 3) Thoroughly wet surface to protect membrane cure and recoat afterward.
 - 4) Complete saw cutting before shrinkage stresses cause cracking.
 - 5. Stake in place load transfer device for expansion joints consisting of dowels:
 - a. Supporting and spacing means and premolded joint filler as per Drawing details.
 - b. Provide preformed joint filler at all junctions with existing curb, sidewalk, steps, or other structures.
 - 6. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
 - 7. Thoroughly clean and fill joints with joint sealing material as specified.
 - 8. Fill joints without overflowing onto pavement surface.
 - 9. Upper surface of filled joint to be flush to 1/8 IN below finish surface.
- E. Place Concrete:
- 1. Comply with Specification Section 03 31 31.
 - 2. Construct driveway openings, ramps, and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
- 1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
 - b. Do not resume until ambient temperature rises to minimum 40 DEGF.
 - c. If placing below 40 DEGF is authorized by Engineer, maintain temperature of mix between 60 and 80 DEGF.
 - d. Heat aggregates or water or both.
 - e. Water temperature may not exceed 175 DEGF.
 - f. Aggregate temperature may not exceed 150 DEGF.
 - g. Remove and replace frost damaged concrete.
 - h. Salt or other antifreeze is not permitted.
 - i. Comply with ACI 306R.
 - 2. Hot weather:
 - a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation of water spray.
 - e. Never batch cement hotter than 160 DEGF.
 - f. Comply with ACI 305R.
- G. Finishing:
- 1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
 - 2. Maintain uniform ridge full width with first pass of first screed.
 - 3. Pavement and similar surfaces:
 - a. Float by longitudinally reciprocating float, passing gradually from edge to edge.
 - b. Assure successive advances do not exceed half the length of the float.
 - c. Test level of slab with minimum 10 FT straightedge.
 - d. Fill depressions with fresh material, consolidate and refinish.
 - e. Cut down high areas and retest.
 - f. Belt surface with two-ply canvas belt, using transverse strokes while advancing along center line.
 - g. Provide final finish by full width burlap or carpet drag, drawn longitudinally.
 - h. Keep drag clean to avoid build up and consequent scarring.
 - i. Tool pavement edges with suitable edger.
 - j. Retest with straightedge and if pavement shows deviation of more than 1/8 IN in 10 FT, remove and replace.

H. Curing:

1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SQFT/GAL.
 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 3. Cure for minimum of seven days.
 4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
 5. Linseed oil sealant:
 - a. Seal surface with linseed oil.
 - b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for one month.
 - c. Apply first application at minimum rate of 67 SQYD per gallon.
 - d. Apply second application to a dry surface at minimum rate of 40 SQYD per gallon.
- I. Protection of Concrete:
1. Protect concrete surfaces and appurtenances from traffic for minimum of 14 days.
 2. Erect and maintain warning signs, lights, watchmen to direct traffic.
 3. Repair or replace parts of concrete surfaces damaged by traffic, or other causes, occurring prior to final acceptance.
 4. Protect concrete pavement against public traffic, construction traffic and traffic caused by employees and agents.
 5. No equipment shall be driven or moved across concrete surfaces unless such equipment is rubber-tired and only if concrete is designed for and capable of sustaining loads to be imposed by the equipment.
 6. Do not drive over new or existing concrete with tracked vehicles and equipment.
- J. Painting and Striping:
1. Stripe and mark pavement per the Drawings following sufficient cure time for pavement.
 2. Lay out markings with guidelines, templates, and forms.
 3. Apply 6 IN wide stripe with self-contained striping machine to a clean and dry pavement surface.
 4. Temperature must be above 40 DEGF and precipitation should not be expected during drying period.
 5. Apply at 1 GAL per 105 SQFT.
- K. Opening to Traffic:
1. After 14 days, pavement may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 LBS per square inch when tested in accordance with ASTM standard methods.
 2. Prior to opening to traffic, clean and refill joints as required with the specified filler material.
- L. Clean Up:
1. Assure clean up work is completed within two weeks after pavement has been opened to traffic.
 2. No new work will begin until clean up work has been completed, or is maintained within two weeks after pavement has been opened to traffic.
- M. Pavement Patching:
1. Comply with material and density requirements as mentioned elsewhere in this Specification except provide minimum 6 IN aggregate immediately below the patch.
 2. Place pavement patch providing a thickened edge.
 3. Assure that patch in plane of "cold" joint has a thickness 6 IN greater than that of the existing pavement.
 4. Extend patch under existing pavement for a distance of 6 IN minimum.
 5. Fill void under existing pavement with concrete.
 6. Undercut existing pavement 6 IN all around patch and to a depth of 6 IN.

7. Prior to placing patch, sawcut edge of existing concrete to 1/4 depth and remove to provide a vertical face for a straight and true joint.

3.3 FIELD QUALITY CONTROL

- A. Provide 3 test cylinders in accordance with Specification Section 03 05 05 for each 100 CU YD or less of concrete placed, as requested by the Quality Assurance Testing Agency.
- B. Pavement Thickness Testing:
 1. General:
 - a. Core pavement to determine the actual thickness as directed by Engineer.
 - b. Determine thickness by ASTM C174/C174M.
 - c. Fill holes from removal of cores with concrete of the same mixture as specified.
 - d. Cost incidental to coring of cores showing a deficiency greater than 1/4 IN shall be paid by the Contractor.
 - e. Cost of cores showing a deficiency of 1/4 IN or less shall be paid by the Owner.
 - f. If average pavement thickness, as directed by core measurement, is outside specified tolerances, payment will be reduced per PART 1 of this Specification Section.
 - g. If deficiency in pavement thickness is 1 IN or more, remove and replace pavement at Contractor's expense.
 2. Core categories:
 - a. In determining the average thickness of acceptable pavement for which payment will be made, utilize the following core categories:

CATEGORY NUMBER	CORE THICKNESS IN RELATION TO DESIGN	CORE LENGTH USED IN CALCULATING
1	1 IN or more deficiency	NOT USED
2	Less than 1 IN deficiency through 1/2 IN excess	Actual Core Thickness
3	More than 1/2 IN excess	Design Thickness plus 1/2 IN

- b. Core sampling:
 - 1) Take cores in each lane in each block.
 - 2) Take cores at locations where the cement content was found to be low when checking the quantities of cement used during the progress of the work.
 - 3) Each separately poured lane of the pavement to be considered as a unit.
 - 4) A lane shall be considered to be the pavement surface between longitudinal construction joints, between a longitudinal construction joint and the edge, or between two pavement edges in cases where the entire width of the pavement is poured in one operation.
 - 5) Should any core show a deficiency in thickness in excess of 1 IN, check cores shall be taken 5 FT on either side of this location parallel to the centerline of the pavement.
 - 6) If both of these cores are within the 1 IN tolerance, no further special borings for this individual zone of deficiency will be made.
 - 7) If either one or both of these cores are not within the 1 IN tolerance, the procedure will be to cut cores in the following order on either side of the original short core parallel to the centerline of the pavement:
 - 1) 25 FT, 50 FT, the same to be measured from the location of original core found to be deficient in thickness, then at 50 FT intervals until a thickness within the 1 IN tolerance is found in both directions.
 - 2) On either side of the original deficient core, the procedure will then be to make a coring approximately half the distance within the first core which comes within the 1 IN tolerance.
 - 3) Repeat the above procedure until the station (+5 FT), at which the pavement comes within the 1 IN tolerance is located.

- 4) If for some reason two or more cores are taken at the same station and at least one of them is beyond the 1 IN tolerance, the section of pavement at the station shall be considered as unacceptable.

END OF SECTION

SECTION 32 16 23
CONCRETE SIDEWALK AND STEPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete sidewalk and steps.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 – Concrete Testing and Inspection.
 - 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - b. M171, Sheet Materials for Curing Concrete.
 - c. M182, Burlap Cloth Made from Jute or Kenaf.
 - d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
 - e. M224, Use of Protective Sealers for Portland Cement Concrete.
 - f. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
 - 2. American Concrete Institute (ACI):
 - a. 305R, Hot Weather Concreting.
 - b. 306R, Cold Weather Concreting.
 - 3. ASTM International (ASTM):
 - a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - b. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - d. C33, Standard Specification for Concrete Aggregates.
 - e. C150, Standard Specification for Portland Cement.
 - f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³).
 - h. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - i. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 4. Federal Specification (FS):
 - a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.
 - b. TT-S 00227 E(3), Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
 - 4. Qualifications of concrete installer.
 - 5. Drawings detailing all reinforcing.
 - 6. Concrete cylinder test results from field quality control.
- B. Samples:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical admixtures:
 - a. Sika Chemical Corporation.
 - b. BASF Admixtures, Inc.
 - c. Protex Industries.
 - d. W. R. Grace and Company.
 - e. Or Equal

2.2 MATERIALS

- A. Portland Cement:
 - 1. ASTM C150, Type I or II.
- B. Water:
 - 1. Potable quality.
- C. Admixtures:
 - 1. Comply with Specification Section 03 31 30.
- D. Reinforcing Bars:
 - 1. ASTM A615, Grade 60.
- E. Welded Wire Reinforcement:
 - 1. ASTM A185 or ASTM A1064.
 - 2. Flat.
 - 3. Clean, free from dirt, scale, rust.
- F. Preformed Joint Filler:
 - 1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
 - 2. Meet AASHTO M153 or AASHTO M213.
- G. Hot-Poured Joint Sealing Material:
 - 1. FS SS-S-1614.
- H. Sidewalk Joint Sealant:
 - 1. Two compound, polyurethane sealant.
 - 2. Class A, Type 1.
 - 3. Self-leveling.

4. Nontracking.
 5. FS TT-S 00227 E(3).
- I. Membrane Curing Compound:
1. ASTM C309.
- J. Cover Materials for Curing:
1. Burlap:
 - a. AASHTO M182.
 - b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 2. Polyethylene film:
 - a. AASHTO M171.
- K. Paper Subgrade Cover:
1. Polyethylene film, AASHTO M171.
- L. Concrete Treatment:
1. Boiled linseed oil mixture.
 2. Meets AASHTO M233.
- M. Forms:
1. Steel or wood.
 2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
 3. Free of distortion and defects.
 4. Full depth.
 5. Metal Side Forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

- A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-1/2 IN +1 IN slump, 6 PCT air.
- B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Preparation:
1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 2. Scarify and recompact top 6 IN of fills and embankments which will be sidewalk and step areas.
 3. Remove soft or spongy areas.
 - a. Replace with aggregate material.
 4. Compact to the following densities:
 - a. Cohesive soils: 95 PCT per ASTM D698.
 - b. Noncohesive soils: 75 PCT relative per ASTM D4253 and ASTM D4254.
 5. Assure moisture content is within limits prescribed to achieve required compaction density.
 6. Following compaction, trim and roll to exact cross section.
 - a. Check with approved grading template.
 7. Perform density tests on subgrade to determine that subgrade complies with the specification.

- B. Aggregate Course:
 - 1. Place material in not more than 6 IN thick layers.
 - 2. Spread, shape, and compact all material deposited on the subgrade during the same day.
 - 3. Compact to 95 PCT relative per ASTM D4253 and ASTM D4254.
- C. Loose and Foreign Material:
 - 1. Remove loose and foreign material immediately before application of paving.
- D. Appurtenance Preparation:
 - 1. Block out or box out curb inlets and curb returns.
 - 2. Provide for joint construction as detailed and dimensioned on Drawings.
 - 3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
 - a. Secure to elevation with concrete.
 - b. Place concrete up to 5 IN below design grade.
 - 4. Clean and oil forms.

3.2 ERECTION, INSTALLATION AND APPLICATION

- A. Concrete Production:
 - 1. Comply with Specification Section 03 31 31.
- B. Forms:
 - 1. Form support:
 - a. Compact soil foundation and cut to grade to support forms.
 - b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - c. Do not use earth pedestals.
 - 2. Staking forms:
 - a. Joint forms neatly and tightly.
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 - 3. Clean and oil forms prior to placement of concrete.
 - 4. Set forms sufficiently in advance of work (minimum 2 HRS) to permit proper inspection.
 - 5. Previously finished pavement or curb and gutter contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
 - 1. Lap mats one full space.
 - 2. Tie end transverse member of upper mat securely to prevent curling.
 - 3. Lap nonwelded bars 12 IN minimum.
 - 4. Support:
 - a. Place bars securely on chairs at called-for height.
 - b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.
- D. Joints:
 - 1. Hold locations and alignment to within + 1/4 IN.
 - 2. Finish concrete surface adjacent to previous section to within + 1/8 IN, with tooled radius of 1/4 IN.
 - 3. Metal keyway joints:
 - a. Form by installing metal joint strip, left in place.
 - b. Stake and support like side form.
 - c. Provide dowels or tie bars.
 - 4. Weakened plane joints:
 - a. Locate at 5 FT intervals.
 - b. Tool groove in freshly placed concrete with tooling device.
 - c. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 - 5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.

6. Expansion joints:
 - a. Locate at 50 FT intervals and at all intersection curb returns.
 - b. Stake in place load transfer device consisting of dowels.
 - c. Supporting and spacing means and premolded joint filler as per Drawing details.
 - d. Provide preformed joint filler at all junctions with existing sidewalks, steps, or other structures.
 7. Thoroughly clean and fill joints with joint sealing material as specified.
 8. Upper surface of filled joint to be flush to 1/8 IN below finish surface.
- E. Place Concrete:
1. Comply with Specification Section 03 31 31.
 2. Construct driveway openings and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
 - b. Do not resume until ambient temperature has risen to 40 DEGF.
 - c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
 - d. Heat aggregates or water or both.
 - e. Water temperature may not exceed 175 DEGF.
 - f. Aggregate temperature may not exceed 150 DEGF.
 - g. Remove and replace frost damaged concrete.
 - h. Salt or other antifreeze is not permitted.
 - i. Comply with ACI 306R.
 2. Hot weather:
 - a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation or water spray.
 - e. Never batch cement hotter than 160 DEGF.
 - f. Comply with ACI 305R.
- G. Finishing:
1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
 2. Maintain uniform ridge full width with first pass of first screed.
 3. Test with 6 FT straightedges equipped with long handles and operated from sidewalk.
 4. Draw excess water and laitance off from surface.
 5. Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.
 6. Broom finish after floating.
 7. Tool edges with suitable edger.
 8. Provide exposed aggregate surfaces in areas indicated on the Drawings.
 9. Provide method such as abrasive blasting, bush hammering, or surface retarder acceptable to the Engineer.
- H. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a rate of minimum 200 SQFT per gallon.
 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 3. Cure for minimum of seven days.
 4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.

5. Linseed oil sealant:
 - a. For concrete sidewalk and step, seal surface with linseed oil.
 - b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for 1 month.
 - c. Apply first application at rate of 67 SQYD per gallon.
 - d. Apply second application to a dry surface at rate of 40 SQYD per gallon.
- I. Protection of Concrete:
 1. Protect new sidewalk, steps, and their appurtenances from traffic for a minimum of 14 days.
 2. Repair or replace parts of sidewalk and steps damaged by traffic, or other causes, prior to final acceptance.
- J. Opening to Traffic:
 1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured cylinders have attained a compressive strength of 3000 LBS per square inch when tested in accordance with ASTM standard methods.
 2. Prior to opening to traffic, clean and refill joints as required with specified filler material.
- K. Clean Up:
 1. Assure clean-up work is completed within two weeks after sidewalk has been opened to traffic.
 2. No new work will begin until clean-up work has been completed, or is maintained within 2 weeks after sidewalk has been opened to traffic.
- L. Handrails:
 1. Provide handrails where required and as per Drawing details.

3.3 FIELD QUALITY CONTROL

- A. Provide 3 test cylinders in accordance with Specification Section 03 05 05 for each 100 or less CUYD of placed concrete.

END OF SECTION

SECTION 32 91 13
TOPSOILING AND FINISHED GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Topsoiling and finished grading.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 10 00 - Site Clearing.
 - 4. Section 31 23 00 - Earthwork.
 - 5. Section 32 92 00 - Seeding, Sodding and Landscaping.
- C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Project Data: Test reports for furnished topsoil.

1.3 SITE CONDITIONS

- A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil:
 - 1. Original surface soil typical of the area.
 - 2. Existing topsoil stockpiled under Specification Section 31 10 00.
 - 3. Friable, loamy soil capable of supporting native plant growth.

2.2 TOLERANCES

- A. Finish Grading Tolerance: ± 0.1 FT from required elevations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Correct, adjust and/or repair rough graded areas.
 - 1. Cut off mounds and ridges.
 - 2. Fill gullies and depressions.
 - 3. Perform other necessary repairs.
 - 4. Bring all sub-grades to specified contours, even and properly compacted.
- B. Loosen surface to depth of 2 IN, minimum.
- C. Remove all stones and debris over 2 IN in any dimension.

3.2 ROUGH GRADE REVIEW

- A. Reviewed by Engineer in Specification Section 31 10 00.

3.3 PLACING TOPSOIL

- A. Do not place when subgrade is wet or frozen enough to cause clodding.
- B. Spread and lightly compact to a depth of 4 IN for all disturbed earth areas.
- C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.
- D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.
- E. Provide finished surface smooth and true to required grades.
- F. Restore stockpile area to condition of rest of finished work.

3.4 ACCEPTANCE

- A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.
- B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

SECTION 32 92 00
SEEDING, SODDING AND LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Seeding, sodding and landscape planting:
 - a. Soil preparation.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI):
 - a. Z60.1, American Standard for Nursery Stock.
 - 2. AOAC International (AOAC).
 - 3. ASTM International (ASTM):
 - a. D2028, Standard Specification for Cutback Asphalt (Rapid-Curing Type).
 - b. D5276, Standard Test Method for Drop Test of Loaded Containers by Free Fall.
- B. Quality Control:
 - 1. Fertilizer:
 - a. If Engineer determines fertilizer requires sampling and testing to verify quality, testing will be done at Contractor's expense, in accordance with current methods of the AOAC.
 - b. Upon completion of Project, a final check of total quantities of fertilizer used will be made against total area seeded.
 - c. If minimum rates of application have not been met, Contractor will be required to distribute additional quantities to make up minimum application specified.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Layout drawings:
 - a. Scaled site plan (scale 1 IN = 20 FT or equal to scale of Project site plan Drawing) on reproducible Drawing to show:
 - 1) Structures, sidewalks, pavement, and fences.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.
 - d. Type of herbicide to be used during first growing season to contain annual weeds and application rate.
 - e. Source and location of sod, plants, and plant material, as per Paragraph 3.3A.
 - 4. Certification that each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.
- B. Informational Submittals:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Copies of invoices for fertilizer used on Project showing grade furnished, along with certification of quality and warranty.

1.4 SEQUENCING AND SCHEDULING

- A. Installation Schedule:
1. Provide schedule showing when trees, shrubs, groundcovers and other plant materials are anticipated to be planted.
 2. Show schedule of when lawn type and other grass areas are anticipated to be planted.
 3. Indicate planting schedules in relation to schedule for irrigation system installation, finish grading and topsoiling.
 4. Indicate anticipated dates Engineer will be required to review installation for initial acceptance and final acceptance.
- B. Pre-installation Meeting:
1. Meet with Engineer and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

- A. Subject to compliance with the Contract Documents, the manufacturers and suppliers listed in the applicable Articles below are acceptable.

2.2 MATERIALS

- A. Native Grass Seeding: Certified seed of locally adapted strains.
- B. Soil Amendments:
- C. Asphalt Binder: Emulsified asphalt per State specifications.
- D. Water:
1. Water free from substances harmful to grass or sod growth.
 2. Provide water from source approved prior to use.
- E. Plants:
1. See plant list on Drawings.
 2. Sound, healthy, vigorous, with normal top and root systems, free from disease, insect pests or their eggs, grown in same or colder climatic zone as project.
 - a. Nursery grown stock, freshly dug.
 - 1) No heeled-in, cold storage or collected stock.
 - b. Species and size as indicated on Drawings.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. General:
1. Limit preparation to areas which will be planted soon after.
 2. Provide facilities to protect and safeguard all persons on or about premises.
 3. Protect existing trees designated to remain.
 4. Verify location and existence of all underground utilities.
 - a. Take necessary precaution to protect existing utilities from damage due to construction activity.
 - b. Repair all damages to utility items at sole expense.

5. Provide facilities such as protective fences and/or watchmen to protect work from vandalism.
 - a. Contractor to be responsible for vandalism until acceptance of work in whole or in part.
- B. Preparation for Lawn-Type Seeding, Sprigging, Plugging or Sodding:
 1. Loosen surface to minimum depth of 4 IN.
 2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous matter.
 3. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted.
 4. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
 5. Distribute fertilizer uniformly over areas to be seeded:
 - a. For lawn-type seeding: 30 LBS per 1000 SQFT.
 - b. For pasture seeding: 200 LBS per acre.
 6. Incorporate fertilizer into soil to a depth of at least 2 IN by disking, harrowing, or other approved methods.
 7. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
 8. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture.
 - a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
 - b. Limit fine grading to areas which can be planted soon after preparation.
 9. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

3.2 INSTALLATION

- A. Lawn-Type and Pasture Seeding:
 1. Do not use seed which is wet, moldy, or otherwise damaged.
 2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to September 15 for fall planting, unless otherwise approved by Engineer.
 3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders, or mechanical hand seeders, or other approved equipment.
 4. Distribute seed evenly over entire area at rate of application not less than 4 LBS (PLS) of seed per 1000 SQFT, 50 PCT sown in one direction, remainder at right angles to first sowing.
 5. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds excessive moisture, or other factors.
 - a. Resume work only when favorable conditions develop.
 6. Lightly rake seed into soil followed by light rolling or cultipacking.
 7. Immediately protect seeded areas against erosion by mulching.
 - a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or 5 straws.
 8. Protect seeded slopes against erosion with erosion netting or other methods approved by Engineer.
 - a. Protect seeded areas against traffic or other use by erecting barricades and placing warning signs.
 9. Immediately following spreading mulch, anchor mulch using a rolling coulter or a wheatland land packer having wheels with V-shaped edges to force mulch into soil surface, or apply evenly distributed emulsified asphalt at rate of 10-13 GAL/1000 SQFT.
 - a. SS-1 emulsion in accordance with ASTM D5276 or RC-1 cutback asphalt in accordance with ASTM D2028 are acceptable.
 - b. If mulch and asphalt are applied in one treatment, use SS-1 emulsion with penetration test range between 150-200.
 - c. Use appropriate shields to protect adjacent site improvements.

3.3 PLANTING TREES, SHRUBS, AND GROUND COVERS

- A. Notification:
 - 1. Notify Engineer of source of plants and plant materials at least 30 days prior to planting to permit Engineer's inspection of source qualifications.
- B. Preparation:
 - 1. Handle plants so that roots or balls are adequately protected from breakage of balls, from sun or drying winds.
 - a. Ensure tops or roots of plants are not permitted to dry out.
 - 2. During transportation, protect materials from wind and sun to prevent tops and roots from drying out.
 - 3. Protect tops of plants from damage.
 - a. Plants with damaged tops will be rejected.
 - 4. For purpose of inspection and planting identification, attach durable, legible labels to bundle or container of plant material delivered at the planting site.
 - a. State correct plant name and size of each plant in weather-resistant ink on labels.
 - 5. Do not prune trees and shrubs at nursery.
- C. Planting Season:
 - 1. Plant deciduous shade trees and shrubs any time the ground is suitable between October 15 and June 1.
 - 2. Plant evergreen material between September 1 and June 1.
 - 3. Plant ground covers between March 15 to June 1.
- D. Planting Procedure:
 - 1. Indicate locations of plants for approval by Engineer before excavating plant locations.
 - 2. In event underground construction, utilities, obstructions, or rock are encountered in excavation of plantings, secure alternate locations from Engineer.
 - a. Make said changes without additional compensation.
 - b. Where tree locations fall under existing overhead wires, or crowd existing trees, adjust locations as directed by Engineer.
 - 3. Excavate pits and beds as necessary and in accordance with ANLA/ANSI Z60.1.
 - a. Loosen bottom of pits prior to planting.
 - b. Excavation is unclassified, excavate all materials without additional cost.
 - 4. Tree and shrub pits to be circular in shape with vertical sides at least 1 FT greater in diameter than ball diameter.
 - a. Pit to be of sufficient depth to provide 6 IN of planting soil under ball when set to natural grade.
 - 5. Shrub and ground cover beds:
 - a. Plant shrubs used in mass plantings in individual holes of required size.
 - b. Strip all sod from among mass planting.
 - c. For ground cover beds, remove sod from within limits of bed.
 - d. Add soil amendments as specified and mix or rototill with existing topsoil to a depth of 6 IN.
 - 6. Set plants straight or plumb, in locations when indicated and at such level that after settlement they bear same relationship to finished grade as they did in their former setting.
 - a. Carefully tamp planting soil under and around base of balls to prevent voids.
 - b. Remove burlap, rope and wires from top of balls.
 - c. Do not remove burlap from sides and bottom of balls.
 - 7. Backfill plants with planting soil.
 - a. Tamp to 1/2 depth of pit and thoroughly water and puddle before bringing backfill to proper grade.
 - b. After planting has been completed, flood pit again so that backfill is thoroughly saturated and settled.
 - 8. After planting is complete, form a level saucer 3 IN high around each tree extending to limit of plant pit for watering purposes.

9. Mulch plant pit after saucer has been shaped.
 - a. Mulch to limits of pit and uniformly over ground cover beds to a depth of 3 IN.
 - b. In mass plantings of shrubs, mulch entire area uniformly among shrubs to a depth of 3 IN.
 - c. If mulching is delayed and soil has dried out, water plants thoroughly before spreading mulch.
10. Staking: Stake trees immediately after planting as detailed on Drawings or in accordance with Nursery Standards.
11. Wrap deciduous trees 2 IN or more in caliper by neatly overlapping wrapping material between ground line and second branch.
 - a. Place ties at top and bottom of wrapping material and not more than 12 IN apart between top and bottom ties.
12. Remove dead or damaged branches.
 - a. Thin deciduous material to about two-thirds of initial branching.
 - b. Remove only dead or damaged branches from evergreens.
13. Water plants during planting operations.
 - a. Water each plant a minimum of once each week until final acceptance.
 - b. Apply sufficient water to moisten backfill about each plant so that moisture will extend into the surrounding soil.

3.4 MAINTENANCE AND REPLACEMENT

A. General:

1. Begin maintenance of planted areas immediately after each portion is planted and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
3. Protection of new materials:
 - a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
 - b. Repair and pay for all damaged items.
4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Engineer.

B. Seeded or Sodded Lawns:

1. Maintain seeded lawns: 90 days, minimum, after installation and review of entire project area to be planted.
2. Maintenance period begins at completion of planting or installation of entire area to be seeded or sodded.
3. Engineer will review seeded or sodded lawn area after installation for initial acceptance.
4. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth, uniform lawn, free of weeds and eroded or bare areas.
5. Lay out temporary lawn watering system and arrange watering schedule to avoid walking over muddy and newly seeded areas.
 - a. Use equipment and water to prevent puddling and water erosion and displacement of seed or mulch.
6. Mow lawns as soon as there is enough top growth to cut with mower set at recommended height for principal species planted.
 - a. Repeat mowing as required to maintain height.
 - b. Do not delay mowing until grass blades bend over and become matted.
 - c. Do not mow when grass is wet.
 - d. Time initial and subsequent mowings as required to maintain a height of 1-1/2 to 2 IN.
 - e. Do not mow lower than 1-1/2 IN.

7. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose.
 - a. Anchor as required to prevent displacement.
8. Unacceptable plantings are those areas that do not meet the quality of the specified material, produce the specified results, or were not installed to the specified methods.
9. Replant bare areas using same materials specified.
10. Engineer will review final acceptability of installed areas at end of maintenance period.
11. Maintain repaired areas until remainder of maintenance period or approved by Engineer, whichever is the longer period.

END OF SECTION



DIVISION 40

PROCESS INTERCONNECTIONS



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SECTION 40 05 00
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 Specification Sections include but are not necessarily limited to:
 - 1. Section 09 96 00 - High Performance Industrial Coatings.
 - 2. Section 10 14 00 - Identification Devices.
 - 3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 4. Section 40 05 07 - Pipe Support Systems.
 - 5. Section 40 05 51 - Valves - Basic Requirements.
 - 6. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
 - b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
 - d. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
 - 2. American Iron and Steel Institute (AISI).
 - 3. American Society of Mechanical Engineers (ASME):
 - 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. B40.100, Pressure Gauges and Gauge Attachments.
 - 4. ASTM International (ASTM):
 - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
 - c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - f. A197, Standard Specification for Cupola Malleable Iron.
 - g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

- i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - j. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
 - k. A536, Standard Specification for Ductile Iron Castings.
 - l. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
 - m. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
 - n. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - o. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
 - p. B88, Standard Specification for Seamless Copper Water Tube.
 - q. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - r. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - s. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - t. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - u. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - v. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
 - w. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - x. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - y. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - z. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
 - aa. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 - bb. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
5. American Water Works Association (AWWA):
 - a. B300, Standard for Hypochlorites.
 - b. C200, Standard for Steel Water Pipe - 6 inches and Larger.
 - c. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 inches through 144 inches.
 - d. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
 - e. C606, Standard for Grooved and Shouldered Joints.
 - f. C651, Standard for Disinfecting Water Mains.
 - g. C800, Standard for Underground Service Line Valves and Fittings.
 6. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
 - b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
 7. Chlorine Institute, Inc. (CI):
 - a. Pamphlet 6, Piping Systems for Dry Chlorine.

8. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 9. International Plumbing Code (IPC).
 10. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 69, Standard on Explosion Prevention Systems.
 11. Underwriters Laboratories, Inc. (UL).
- B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

- A. PVDF: Polyvinylidene fluoride.
- B. SCFM: standard cubic feet per minute.
- C. W.C.: water column

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. See PIPING SYSTEMS SCHEDULE in PART 3.

1.5 SUBMITTALS

- A. Shop Drawings:
 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
 - c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
 - 1) Attach technical product data on gaskets, pipe, fittings, and other components.
 2. Fabrication and/or Layout Drawings:
 - a. Exterior yard piping drawings (minimum scale 1 inch equals 10 feet) with information including:
 - 1) Dimensions of piping lengths.
 - 2) Invert or centerline elevations of piping crossings.
 - 3) Acknowledgement of bury depth requirements.
 - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
 - 5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
 - 6) Line slopes and vents.
 - b. Interior piping drawings (minimum scale 1/8 inches equals 1 foot) 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) Acknowledgement 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.
- B. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
- 1. Qualifications of lab performing disinfection analysis on water systems.
 - 2. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe coating during handling using methods recommended by manufacturer.
- 1. 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.
- 1. Repair abrasions, scars, and blemishes.
 - 2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Dry disconnect couplings:
 - a. Kamlock.
 - 2. Pipe saddles (for gage installation):
 - a. Dresser Style 91 (steel and ductile iron systems).
 - b. Dresser Style 194 (nonmetallic systems).
 - c. .
 - 3. Elastomeric bellows type expansion joints:
 - a. Garlock, Guardian 200/204.
 - b. PROCO, equivalent model.
 - c. Red Valve, equivalent model.
 - d. Or equal.
 - 4. Dismantling Joint
 - a. Romac DJ400.
 - b. Smith Blair 972.
 - 5. Air inlet filter:
 - a. Endustra Tri-Vent Series TZ09.
 - b. Solberg Manufacturing, F-391-1800F.

2.2 PIPING SYSTEMS SCHEDULE

- A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping systems schedule located at the end of PART 3 of this Specification Section.

2.3 COMPONENTS AND ACCESSORIES

- A. Insulating Components:

1. Dielectric flange kits:
 - a. Flat faced.
 - b. 1/8 inches thick dielectric gasket, phenolic, non-asbestos.
 - c. Suitable for 175 psi, 210 degrees F.
 - d. 1/32 inches wall thickness bolt sleeves.
 - e. 1/8 inches thick phenolic insulating washers.
 2. Dielectric unions:
 - a. Screwed end connections.
 - b. Rated at 175 psi, 210 degrees F.
 - c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.
- B. Air inlet filters:
1. Rated flow of 5,000 SCFM or greater.
 2. Polyester filter media with maximum opening size of 10 microns.
 - a. Filter media shall be washable for extended service life.
 3. Maximum clean pressure drop: 5-in W.C.
 - a. Filter change-out differential: 15- to 20-in W.C. over initial pressure drop
 4. Filters shall have RAL 7040 powder-coat finish or Owner-approved alternative.
 5. Service temperature: -15 to 220 DEGF
 6. Flanged connections.
- C. Reducers:
1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
 2. 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, coating, tests and other items are specified.
 2. Field coating pipe in accordance with Specification Section 09 96 00.
- E. Underground Warning Tape:
1. See Specification Section 10 14 00.
- F. 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 inches and below from polypropylene.
 - 1) Above 3 inches 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 inches and less from polypropylene with stainless steel arms and pins.
 - 1) Above 3 inches, provide stainless steel units.
 - e. Gasket: Compatible with conveyed liquid.
 3. Dust caps: For all adapters.
- G. Sacrificial Anode Cathodic Protection:

1. 3 pound magnesium sacrificial anodes, prepackaged in a cloth bag containing 75% hydrated gypsum, 20% bentonite and 5% anhydrous sodium sulphate.
 2. TW 600 V or an HMWPE insulated copper lead attached to the anode.
- H. Valves:
1. See schematics and details for definition of manual valves used in each system under 4 inches in size.
 - a. See Specification Section 40 05 51 schedule for valve types 4 inches and above and for automatic valves used in each system.
 2. See Specification Section 40 05 51.
- I. Elastomeric Bellows Type Expansion Joints:
1. Provide reducing type where indicated on the Drawings.
 2. Air piping: Refer to stainless steel Specification 40 05 23.
 3. Flanges: ANSI 125/150.
 4. Materials:
 - a. Bellows:
 - 1) Sludge service: Natural rubber.
 - 2) Hot Water (over 100 degrees F): EPDM.
 - 3) All other: Compatible with fluid.
 - b. Restraint:
 - 1) Provide restraint limit bolts (control rods) and nuts to restrain joint at test pressure of piping.
 - 2) Control rod material: 316 stainless steel.
 - c. Working pressure: Equal to or greater than test pressure of connecting piping.
 - d. Minimum axial movement: 3/8 inches.
 5. Arches:
 - a. Sludge service: Provide single filled arches.
 - b. All other service: Provide double open arches.

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

- A. Unless otherwise shown on the Drawings, provide a minimum of 5 feet and maximum of 8 feet 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 Specification Section 01 73 20 and as shown on Drawings.
- C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 feet of point where pipe enters or leaves structure.
 1. Install second joint not more than 6 feet nor less than 4 feet 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 Specification Section 31 23 33.
 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 alongside of pipe or final with bedding material placed.
 6. Lay pipe in only suitable weather with good trench conditions.
 - a. 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.
 - a. Concrete blocks shall not cover pipe joints.
 3. Provide bearing area of concrete in accordance with drawing detail.
- H. Install underground hazard warning tape per Specification Section 10 14 00.
- I. Install insulating components where dissimilar metals are joined together.

3.2 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 inches 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 Specification Section 01 73 20 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 Specification Section 40 05 07.
 2. 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.
 - a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
 3. Size pipe supports with consideration to specific gravity of liquid being piped.
- F. Locate and size sleeves and castings required for piping system.
 1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- G. Use reducing fittings throughout piping systems.
 1. 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.
 - a. Size to handle application with 3/4 inches 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.
 - 1) 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.
 - 1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - 2) Realign as necessary, install flange bolts and make equipment connection.
 - i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
 - 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.
 - 1) Provide wheel handle stop valve at each laboratory sink water supply.

- 2) Minimum size: 1/2 inches.
 - d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.
 - 1) Size trap as required by IPC.
 - 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. Instrument Connections:
- 1. See drawing details.

3.3 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 this Specification Section.
- G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.4 ACCESS PROVISIONS

- A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.
- B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 inches size.
- C. 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.
- D. Provide with key locks, keyed alike, in public use areas.
- E. Furnish panels with prime coat of HPIC. See Specification Section 09 96 00.
- F. Style and type as required for material in which door installed.
- G. Where door is installed in fire-rated construction, provide door bearing UL label required for condition.

3.5 CATHODIC PROTECTION

- A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.
- B. Make all connections from wire or cable by Thermit Cadwelding accomplished by operators experienced in this process.
- C. Install all cables with a loop and overhead knot around each pipe and slack equal to at least 50% of the straight line length.

D. After cadwelding, coat all exposed metallic surfaces with hot applied tape.

3.6 PRESSURE GAGES

- A. Provide at locations shown on the Drawings and specified.
- B. See Specification Section 01 61 03.

3.7 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. Isolate equipment which may be damaged by the specified pressure test conditions.
 - 3. 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 hours prior to each test.
 - 4. Completely assemble and test new piping systems prior to connection to existing pipe systems.
 - 5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
 - 6. 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 SYSTEMS SCHEDULE, utilize the following test media.
 - a. Process systems:

PIPE LINE SIZE	SPECIFIED TEST PRESSURE	TESTING MEDIUM
2 inches and smaller	75 psi or less	Water
2 inches and smaller	Greater than 75 psi	Water
Greater than 2 inches	3 psi or less	Water
Greater than 2 inches	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 inches	Gravity	25 psiG or less	Water
Above 48 inches	Gravity	25 psiG or less	Water
All sizes	Pumped	250 psiG or less	Water

2. Allowable leakage rates:
 - a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage goal at the specified test pressure throughout the duration of the test.
 - b. Hydrostatic exfiltration and infiltration for sanitary and stormwater 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 feet.
 - 2) Average head is defined from groundwater elevation to average pipe crown.
 - 3) Acceptable test head leakage rate for heads greater than 3 feet: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 by (actual test head to the 1/2 power).
 - c. Hydrostatic infiltration test for sanitary and stormwater 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 to 6 feet.
 - 2) Leakage rate at heads greater than 6 feet: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 by (actual head to the 1/2 power).
 - d. Large diameter (above 48 inches) gravity plant piping systems shall have a maximum exfiltration of 25 GPD per inch-mile.
 - e. Non-hazardous gas and air systems which are tested with air shall have a maximum pressure drop of 5% 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 feet
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3
48	7.6

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 coat 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 feet above highest stack inlet.
- c. Larger diameter (above 36 inches) gravity plant piping:
- 1) Plug downstream end of segment to be tested.
 - a) Provide bracing as required.
 - 2) Fill segment and upstream structure to normal operating level as per hydraulic profile.
 - 3) Allow 24 hours for absorption losses.
 - a) Refill to original level.
 - 4) Provide reservoir to maintain constant head over duration of test.
 - 5) Record reservoir water volume at beginning and end of test.
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 glycerin.
 - 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 manufacturer's designated seal pressure.
 - 2) Check plugs for proper sealing.
 - 3) Introduce low pressure air into sealed line segment until air pressure reaches 4 psiG greater than ground water or allowable limits of ASTM F1417.
 - a) Use test gage conforming to ASME B40.100 with 0 to 15 psi scale and accuracy of 1% of full range.
 - 4) Allow 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.
- 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.

3.8 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.
 - a. Pig high pressure air piping before connecting to valves or instruments.

4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
 - a. 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.
 - b. 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.
 5. After erection of piping and tubing, but prior to installation of service outlet valves, blow natural gas and digester gas systems clear of free moisture and foreign matter by means of air, nitrogen or carbon dioxide.
 - a. Oxygen shall never be used.
 6. Clean chlorine piping in accordance with CI Pamphlet 6.
 7. Purge all neat liquid polymer tubing or piping between the neat polymer storage tank or tote and the polymer blending units with mineral oil to remove residual water prior to introducing neat polymer. Following purging, drain as much of the mineral oil out of the system as possible. Dispose of purged fluids and waste mineral oil in accordance with local environmental regulations.
- 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.
 3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
 4. Flush each segment of system to provide flushing velocity of not less than 2.5 feet per second.
 5. Drain flushing water to sanitary sewer.
 - a. Do not drain flushing water to receiving stream.
 6. Use continuous feed method of application.
 - a. Tag system during disinfection procedure to prevent use.
 7. After required contact period, flush system to remove traces of heavily chlorinated water.
 8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
 - a. Repeat entire disinfection procedures until satisfactory results are obtained.
 9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.
 - a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of Idaho.

3.9 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.

3.10 PIPE INSULATION

- A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

3.11 GASKET MATERIAL SCHEDULE

- A. Table A: Material Rating for Elastomers:
 1. X: Used for service identified.

2. -: Not used for service identified.

Service Material	NEOPRENE	BUNA-N	NATURAL	URETHANE	EPDM	SILICONE	HYPALON	VITON	TEFLON
Process Air	-	-	-	-	X	-	-	-	-
Mixed liquor	-	X	-	-	-	-	-	X	-

3.12 PIPING SYSTEM SCHEDULES

- A. Piping System 3 – Buried and Exposed, Stainless Steel, Process Piping Operating Under Pressure at up to 100 psiG.
1. General:
 - a. Piping symbol and service:
 - 1) ML – Mixed Liquor.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 1.25 x working pressure.
 - 3) Duration: 6 hours.
 - c. Gaskets:
 - 1) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
 - 2) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
 - 3) Flanged joints (steel): Rubber, AWWA C207.
 2. System components:
 - a. Pipe size less than 3 inches:
 - 1) Buried, submerged and exposed service:
 - a) Material: Stainless steel 304L, Schedule 40.
 - b) Reference: ASTM A778.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Seamless steel 304L meeting ASTM A774.
 - f) Joints:
 - (1) Butt welded with flanges at equipment and valves.
 - (2) Harnessed compression sleeve couplings where indicated on Drawings.
 - b. Pipe size 3 inches through 24 inches:
 - 1) Buried, submerged and exposed service:
 - a) Material: Stainless steel 304L, Schedule 10.
 - b) Reference: ASTM A778.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Seamless steel 304L meeting ASTM A774.
 - f) Joints:
 - (1) Butt welded with flanges at equipment and valves.
 - (2) Harnessed compression sleeve couplings where indicated on Drawings.

B. Piping System 12 – Exposed Process Piping for Low-Pressure Air Service up to 25 psiG.

 1. General:
 - a. Piping symbol and service:
 - 1) ALP – Air Low Pressure.
 - b. Test requirements:
 - 1) Test medium: Air.
 - 2) Pressure: 20 psiG.
 - 3) Duration: 6 hours.
 - c. Gaskets and O-rings:
 - 1) O-rings and flanged joints: Silicone.
 - d. Temperature:
 - 1) Normal: 205 DEGF.

- 2) Maximum: 250 DEGF.
- 2. System components:
 - a. Buried, submerged, and exposed service:
 - 1) Material: Stainless steel 304L, Schedule 10.
 - 2) Reference: ASTM A778.
 - 3) Lining: None.
 - 4) Coating: None.
 - 5) Fittings: Seamless steel 304L meeting ASTM A774.
 - 6) Joints:
 - a) Butt welded with flanges at equipment and valves.
 - b) Harnessed compression sleeve couplings where indicated on Drawings.
 - b. Submerged service:
 - 1) Material: PVC, Type 1, Grade 1, Schedule 40.
 - 2) Reference: ASTM D1785
 - 3) Lining: None.
 - 4) Coating: None.
 - 5) Fittings: Solvent welded socket type complying with ASTM D2466.
 - 6) Joints: Solvent welded.

3.13 SERVICE SYSTEM SUMMARY

A. Service Systems as defined in Table B:

TABLE B - SERVICE SYSTEM SUMMARY						
SYMBOL	SERVICE	SYSTEM NO	CONSTRUCTION	SIZE (IN)	PIPE MATERIAL	TEST PRESSURE SPECIFIER (PSI)
ALP	Low pressure Process Air	12	Exposed, submerged, and buried	All	Stainless steel	20
ML	Mixed liquor	3	Exposed, submerged, and buried	All	Stainless steel	(4)
NOTES:	(1) Low pressure, generally less than 20 psi					
	(2) Based on stack height plus 10 feet					
	(3) No pressure test, visual only					
	(4) 125% system pressure					
	(5) Gas company requirements					
	(6) Infiltration/Exfiltration testing					

END OF SECTION

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SECTION 40 05 07
PIPE SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe support and anchor systems.
 - 2. Design of Pipe Support Systems as specified.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 01 81 10 - Wind and Seismic Design Criteria
 - 2. Section 03 15 19 - Anchorage to Concrete.
 - 3. Section 05 50 00 - Metal Fabrications.
 - 4. Section 09 96 00 - High Performance Industrial Coatings.
 - 5. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B31.3, Process Piping.
 - 2. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A123/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. A153/153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - e. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 - f. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
 - g. A917, Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements).
 - h. A918, Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
 - i. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 3. American Welding Society (AWS):
 - a. D1.1, Structural Welding Code - Steel.
 - b. D1.6, Structural Welding Code - Stainless Steel.
 - 4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- B. Responsibility:
 - 1. Support systems for piping greater than 12 inches diameter, or with internal pressure over 100 psi, or piping with product temperatures over 200 degrees F, are shown on the Drawings and are not to be designed by Contractor unless indicated in Contract Documents.
 - 2. Design complete support systems for piping 12 inches and smaller where supports are not shown on the Drawings.
 - 3. Provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.

4. General piping support details may be indicated on the Drawings in certain locations for pipe 12 inches diameter and smaller.
 5. Incorporate those details with requirements of this Specification Section to provide the piping support system.
- C. Each type of pipe hanger or support shall be the product of one manufacturer.
- D. Qualifications:
1. Pipe support designer:
 - a. Licensed Professional Engineer registered in the state the project is located in.
 - b. Minimum of five years experience designing pipe supports for projects of similar size and complexity.

1.3 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Scaled drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
 - b. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.
 - c. Where Contract Documents indicate contractor is to design pipe support systems, submit detail design calculations and scaled drawings signed by Pipe support designer.
 2. Product data:
 - a. Acknowledgement 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.
- B. Informational Submittals:
1. Certifications.
 - a. Pipe support designer qualifications

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Empire Industries, Inc.
 2. ASC Engineered Solutions (ANVIL).
 3. National Pipe Hanger Corp.
 4. PHD Manufacturing, Inc.
 5. Atkore International (Unistrut, Powerstrut and Aickinstrut).
 6. Or Equal.

2.2 MANUFACTURED UNITS

- A. General:
1. Galvanized components:
 - a. Hot-dip galvanized components:
 - 1) General: ASTM 123/123M.
 - 2) Fasteners and hardware: ASTM 153/153M.
 2. Dissimilar metals protection:
 - a. Galvanized-to-galvanized and galvanized-to-aluminum: No protection required.
 - b. All other galvanized-to-dissimilar metal connections: Neoprene or nylon pads, shims, grommets, etc.
 3. Fiberglass Reinforced Plastic (FRP) components:
 - a. Material: Polyester.

- b. Channels: similar to Aickinstrut F2000 or F2100.
- c. Pipe Clamps: similar to Aickinstrut FPS or FRPC.
- d. Clevis Hangers: similar to Aickinstrut FMCH.
- e. Beam Clamp: similar to Aickinstrut FMBC.
- f. Column Base: similar to Aickinstrut F2852, F5853 or 5854

B. Hanger Rods:

- 1. Material:
 - a. ASTM A36.
 - b. ASTM A575, Grade M1020.
 - c. ASTM A576, Grade 1020.
 - d. Minimum allowable tensile stress of 12,000 psi at 650 degrees F per MSS SP-58.
- 2. Continuously threaded.
- 3. Hot-dip galvanized after threads are cut.
- 4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 inches diameter (min)	610
1/2 inches diameter	1,130
5/8 inches diameter	1,810
3/4 inches diameter	2,710
7/8 inches diameter	3,770
1 inches diameter	4,960

C. Hangers:

- 1. Hangers for use directly on copper pipe: Copper plated or PVC coated.
- 2. Hangers for use other than directly on copper pipe: 304 stainless steel.
- 3. Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 inches and less	MSS Type 1 or 12 Similar to Empire Figure 41.
All except noted	Over 4 inches	MSS Type 1 Similar to Empire Figure 11.
Steam, condensate, and hot water	All	MSS Type 43 Similar to Empire Figure 272 w/ spring hanger.
Service in chemical storage areas and as indicated on drawings for corrosion resistance	All	FRP trapeze hangers or clevis hangers as specified below.

D. Concrete Inserts for Hanger Rods:

- 1. Continuous slots: Unistrut #P1000.
- 2. Individual inserts: Similar to ANVIL Figure 281.
- 3. See Specification Section 03 15 19, mechanical anchors.

E. Beam Clamps for Hanger Rods:

- 1. MSS SP-58, Type 21.
- 2. Material: 304 stainless steel.

3. Standard duty.
 4. Similar to Empire Industries Figure 155.
- F. Trapeze Hangers for Suspended Piping:
1. General:
 - a. Material: 304 stainless steel.
 - b. Angles, channels, or other structural shapes.
 - c. Curved roller surfaces at support point corresponding with type of hanger required.
 - d. See Specification Section 05 50 00.
 2. In chemical storage and feed areas and as indicated on the drawings:
 - a. Materials: 304 stainless steel.
 - b. Aikinstrut fiberglass channel or equal.
- G. Vertical Pipe Supports:
1. At base of riser.
 - a. Material: 304 stainless steel.
 2. Lateral movement:
 - a. Clamps or brackets:
 - 1) MSS SP-58, Type 8 or 42.
 - 2) Similar to Empire Industries Figure 50.
- H. Expanding Pipe Supports:
1. Spring hanger type.
 2. MSS SP-58, Type 51.
- I. Pipe Support Saddle:
1. For pipe located 3 feet or less from floor elevation, except as otherwise indicated on Drawings.
 2. MSS SP-58 Type 38.
 3. Material: 304 stainless steel.
 4. Similar to Empire Industries Figure 426.
- J. Pipe Support Risers/Stanchions:
1. Schedule 40 pipe.
 2. Material: match pipe support saddle.
 3. Size: As recommended by saddle manufacturer.
- K. Pipe Support Base Plate:
1. 4 inches larger than support.
 2. Collar 3/16 inches thickness, circular in shape, and sleeve type connection to pipe.
 3. Collar fitted over outside of support pipe and extended 2 inches from floor plate.
 4. Collar welded to floor plate.
 5. Edges ground smooth.
 6. Material: match pipe support saddle.
 7. Assembly hot-dip galvanized after fabrication.
 8. Provide low carbon stainless steel for welded fabrications.
- L. Pipe Covering Protection Saddle:
1. For insulated pipe at point of support.
 2. MSS SP-58 Type 40.
 3. Material: 304 stainless steel.
 4. Stainless steel: Similar to Empire Industries Figure 167.
- M. Wall Brackets:
1. For pipe located near walls and 8 feet or more above floor elevation or as otherwise indicated on the Drawings.
 2. MSS SP-58, Type 33.
 3. Material: 304 stainless steel.
 4. Similar to Empire Industries Figure 802.

- N. Pipe Anchors:
 1. For locations shown on the Drawings.
 2. 1/4 inches steel plate construction.
 3. Hot-dip galvanized after fabrication.
 4. Designed to prevent movement of pipe at point of attachment.
- O. 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. Material: 304 stainless steel.
 4. Similar to Empire Industries Figure 255.

2.3 DESIGN REQUIREMENTS

- A. Supports capable of supporting the pipe for all service and testing conditions.
 1. Provide 5 to 1 safety factor.
- 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. ASME B31.3.
 2. MSS SP-58.
 3. Except where modified by this Specification.
- E. For steam and hot and cold water process piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
 1. ASME B31.1.
 2. MSS SP-58.
- 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.
 1. Support pipes for lateral movement with clamps or brackets.
- H. Place hangers are to be installed on outside of pipe insulation.
 1. Use a pipe covering protection saddle for insulated pipe at support point.
 2. Insulated piping 1-1/2 inches and less:
 - a. Provide a 9 inches length of high density perlite or high density calcium silicate at saddle.
 3. Insulated piping over 1-1/2 inches: Provide a 12 inches length of high density perlite or high density calcium silicate at saddle.
 4. See Specification Section 40 42 00.
- I. Provide 20 GA pipe saddle for fiberglass and plastic pipe support points to ensure minimum contact width of 4 inches.
 1. Material: match support.
- J. Pipe Support Spacing:
 1. General:
 - a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
 - b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
 - c. 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
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

3. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

* Maximum fluid temperature of 120 degrees F.

4. 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 feet of each side of fittings to keep pipes in alignment.
5. Space supports for soil and waste pipe and other piping systems not included above every 5 feet.
6. Provide continuous support for nylon tubing.

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 ASME B31.3.
 3. AWS D1.6 for stainless steel supports.
- 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. Anchorage to Concrete - reference Specification Section 03 15 19.

- G. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
 - 1. Install concrete inserts as concrete forms are installed.
- H. 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: ASME B31.3, Chapter V.
- I. Field Painting:
 - 1. Comply with Specification Section 09 96 00.

END OF SECTION

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SECTION 40 05 23
PIPE STAINLESS STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Stainless steel tubing, piping, fittings, and appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 REFERENCES

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250).
 - b. B31.1, Power Piping.
 - 2. ASTM International (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, Standard Specification for Seamless, Welded, and Heavy Cold Worked Austenitic Stainless Steel Pipes.
 - d. A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
 - e. A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - f. A530, Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
 - g. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - h. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
 - i. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
 - 3. American Welding Society:
 - a. AWS D10.4-86R, Recommended Practices for Welding Austenitic Chromium – Nickel Stainless Steel Piping and Tubing.
 - 4. Nickel Development Institute (NiDI):
 - a. Publication 11 007, Guidelines for the Welded Fabrication of Nickel-Containing Stainless Steels for Corrosion Resistant Services.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Product technical data including:
 - 1) Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Free iron contamination test method
- B. Informational Submittals: Submit the following:
 - a. Fabrication details and welding procedure specifications for all work to be done under this Specification Section.

- C. See Specification Section 40 05 00 for additional piping submittal requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Tubing:
 - 1. ASTM A269.
 - 2. Filler material: Extra low carbon (ELC) with 0.03% maximum carbon.
- B. Pipe, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. ASTM A778.
 - 2. ASTM A312.
- C. Pipe Fittings:
 - 1. ASTM A774.
- D. Flanges, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. Flat faced.
 - 2. Welding neck or slip on type.
 - 3. ASTM A182, Type 316L.
- E. Nuts, Bolts and Washers, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. ASTM A320, Type 316.
 - 2. Provide two (2) nuts for 1 inch diameter bolt applications and larger.
- F. Elastomeric Bellows Type Expansion Joint (for hot air service):
 - 1. Refer to Section 40 05 00 for expansion joints for liquid service.
 - 2. Manufacturers:
 - a. Mercer Series 500 or equal.
 - 3. Two Arch construction.
 - 4. Material: EPDM (tube and cover)
 - 5. Restraint: Provide control rods sized to restrain joint at test pressure.
 - a. Materials: 316 stainless steel.
 - 6. Allow for minimum of 1 inch of lateral movement.
 - 7. Pressure Rating: Working pressure of joint equal or greater than test pressure of connecting piping. Provide minimum 25 psig rating.
- G. Gasket Material, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. Rubber or neoprene.
 - 2. Temperature rating of 250 degrees F.
- H. Flexible Metal Hose:
 - 1. General: Braided stainless steel flexible hose.
 - 2. Connections: Provide ANSI B 16.1 125 lb. flanged connections.
 - 3. Length: Minimum 12 inches or as noted on the Drawings.
 - 4. Pressure: Working pressure of hose equal or greater than test pressure of connecting piping.

2.2 FABRICATION

- A. Shop Welding:
 - 1. Weld stainless steel in accordance with AWS D10.4-86R and NiDI 11 007.
 - 2. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not less than pipe.
 - 3. Perform butt welds only with an inert gas shielded process.
 - 4. Provide adequate inert gas protection to the top and under or backside of the weld to protect from atmospheric contamination.

5. Provide filler metal for all manually-performed welds appropriate for the base material being welded.
 6. Use only inert gas shielded welding processes for spool fabrication.
 7. Provide butt welds with 100% penetration to the interior or back side of the weld joint.
 8. Weld reinforcement on both sides of the weld is to be smooth, uniform and no more than 1/16 inches in height.
- B. Diameter tolerance and wall thickness tolerance are to conform to ASTM A530.
- C. Joints:
1. Shop welded circumferential butt weld joints.
 2. ASME B16.1, Class 150.
- D. Elastomeric Bellows Type Expansion Joints:
1. Ensure aerial travel in expansion joints of 3.1 inches minimum for 15,000 cycles or 5.2 inches for 1000 cycles.
 2. Furnish each assembly with a minimum of two control tie rods.
 3. Fabricate with 125 pound flanged end connections.
- E. Expansion Joints:
1. Fabricate for 25 psi internal pressure and 250 degrees F operation.
 2. Ensure aerial travel in expansion joints of 3.1 inches minimum for 15,000 cycles or 5.2 inches for 1000 cycles.
 3. Furnish each assembly with minimum four control tie rods.
 4. Fabricate with 125 pound flanged end connections.
- F. Passivation
1. For components/assemblies to be used only in dry air service environments:
 - a. No post-fabrication passivation treatments are required for external corrosion control.
 2. For components/assemblies to be used in outdoor atmospheric service environments:
 - a. For external corrosion control, pickle/passivate all stainless steel tube, piping, fitting products to remove dirt, weld heat tint, weld slag, free iron contamination, and other surface contaminants suffered during fabrication.
 - b. Following the conclusion of fabrication operations, just prior to shipping, pickle/passivate all fabricated components per the requirements of ASTM A380 or other acceptable means as listed in NiDI 11 007 and approved by the Engineer.
 - c. For assemblies containing crevices, joints, flanges, gaskets, pockets, etc. that cannot be completely rinsed to remove passivating acids/chemicals following the passivating process: disassemble prior to passivation, then reassemble after rinsing/drying.
 - d. Protect passivated assemblies from additional carbon steel surface contamination or other contaminants during all subsequent packing, shipping, handling, and installation operations as described in ASTM A380.
 3. For components/assemblies to be used in corrosive service environments:
 - a. For external corrosion control, pickle/passivate all stainless steel tube, piping, fitting products to remove dirt, weld heat tint, weld slag, free iron contamination, and other surface contaminants suffered during fabrication.
 - b. Following the conclusion of fabrication operations, just prior to shipping, pickle/passivate all fabricated components per the requirements of ASTM A380 or other acceptable means as listed in NiDI 11 007 and as approved by the Engineer.
 - c. For assemblies containing crevices, joints, pockets, etc. that cannot be completely rinsed to remove passivating acids/chemicals following the passivating process disassemble prior to passivation, then reassemble after rinsing/drying.
 - d. Demonstrate that all free iron contamination has been removed from all stainless steel surfaces per one of the free iron test methods listed in ASTM A380.
 - 1) Submit the free iron contamination test method to be used for approval in advance by the Engineer.
 - 2) Test results must be approved by the Engineer.

- e. Protect passivated assemblies from additional carbon steel surface contamination or other contaminants during all subsequent packing, shipping, handling, and installation operations as described in ASTM A380.
- 4. Control and dispose solvents and acid cleaning solutions used by the fabricator according to all applicable federal, state, and local pollution control regulations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation, inspect and verify condition of piping and appurtenances.
 - 1. 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 ASME B31.1.
 - 1. Lubricate all pipe threads with Teflon tape.
- B. Field Welding:
 - 1. Weld stainless steel in accordance with AWS D10.4-86R and NiDI 11 007.
 - 2. For welding on existing lines, clean and purge lines prior to welding.
 - 3. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not less than pipe.
 - 4. Perform butt welds only with an inert gas shielded process.
 - 5. Provide adequate inert gas protection to the top and under or backside of the weld to protect from atmospheric contamination.
 - 6. Apply filler metal for all manually-performed welds appropriate for the base material being welded.
 - 7. Use only inert gas shielded welding processes for spool fabrication.
 - 8. Provide butt welds with 100% penetration to the interior or back side of the weld joint.
 - 9. Weld reinforcement on both sides of the weld is to be smooth, uniform and no more than 1/16 inches in height.
 - 10. Following completion of field welding, remove all dirt, weld heat tint, weld slag, free iron contamination, and other surface contaminants suffered during field welding.
 - a. For external corrosion control, follow the pickling/passivation/cleanliness requirements of Article 2.2, Paragraph F of this specification section.
 - b. Additional methods listed in ASTM A967, Section 8 may be used for passivation with engineer approval.
- C. Joining Method - Flanges:
 - 1. Leave 1/8 inches to 3/8 inches flange bolts projection beyond face of nut after tightening.
 - a. Coordinate dimensions and drillings of flanges with flanges for valves, equipment, and other systems.
 - b. Tighten bolts evenly around pipe until following range of torques is achieved:

BOLT SIZE, IN	RANGES OF TORQUE, FT/LBS
5/8	40 - 60
3/4	60 - 90
1	70 - 100

BOLT SIZE, IN	RANGES OF TORQUE, FT/LBS
1-1/4	90 - 120

D. Expansion Joints:

1. Install in accordance with manufacturer's instructions.
2. Apply anti-seize compound to all exposed steel threads.

3.4 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Specification Section 40 05 00.

3.5 CLEANING

- A. Clean in accordance with Specification Section 40 05 00.

END OF SECTION

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SECTION 40 05 51
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. Section 01 61 03 - Equipment - Basic Requirements.
 - 2. Section 09 96 00 - High Performance Industrial Coatings.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 - 4. Section 40 05 64 - Butterfly Valves.
 - 5. Section 40 05 66 - Check Valves.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B1.20.1, Pipe Threads, General Purpose.
 - b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASTM International (ASTM):
 - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
 - c. D638, Standard Test Method for Tensile Properties of Plastics.
 - d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
 - e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
 - f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - 3. American Water Works Association (AWWA):
 - a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 inches through 144 IN.
 - b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - c. C504, Standard for Rubber-Seated Butterfly Valves.
 - d. C507, Standard for Ball Valves, 6 inches through 48 inches (150 mm through 1200 mm).
 - e. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
 - f. C550, Standard for Protective Coatings for Valves and Hydrants.
 - g. C606, Standard for Grooved and Shouldered Joints.
 - 4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. MG 1, Motors and Generators.
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).

1.3 DEFINITIONS

- A. The following are definitions of abbreviations used in this Specification 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. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Valve pressure and temperature rating.
 - d. Valve material of construction.
 - e. Special linings.
 - f. Valve dimensions and weight.
 - g. Valve flow coefficient.
 - h. Wiring and control diagrams for electric or cylinder actuators.
 - i. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
 2. Test reports.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
1. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.
- D. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

2.2 MATERIALS

- A. Refer to individual valve Specification Sections.

2.3 VALVE ACTUATORS

- A. Valve Actuators - General:
1. Provide actuators as shown on Drawings or specified.
 2. Counter clockwise opening as viewed from the top.
 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
 4. Size actuator to produce required torque with a maximum pull of 80 pound at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 pound on handwheel or chainwheel or 300 feet-pounds torque on the operating nut.
 5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 feet of submergence.

6. Extension stem:
 - a. Install where shown or specified.
 - b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
 - c. Pin all stem connections.
 - d. Center in valve box or grating opening band with guide bushing.
- B. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
 2. Provide handwheels for gate and globe valves.
 - a. Size handwheels for valves in accordance with AWWA C500.
 3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 inches diameter and smaller.
 - a. Lever actuators for butterfly valves shall have a minimum of five intermediate lock positions between full open and full close.
 - b. Provide at least two levers for each type and size of valve furnished.
 4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 inches diameter and larger.
 5. Provide gearing for gate valves 20 inches 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 feet or higher from finish floor to valve centerline.
 - a. Cadmium-plated chain looped to within 3 feet of finish floor.
 - b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
 - c. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.
 8. Provide cast iron floor stands where shown on Drawings.
 - a. Stands to be furnished by valve manufacturer with actuator.
 - b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.
- C. Electric Actuators (480 V, 3 PH):
1. Electric Motor Actuators - General:
 - a. Provide electric motor actuators for valves and gates so indicated: on the Drawings, in valve schedule in the Specifications, or elsewhere in the Contract Documents.
 - b. Unless otherwise specified, provide each electric motor actuator with integral control devices for operation, including pushbuttons. When actuator's integral control station would be 6 feet or more above the nearest operating floor, or when integral control station would be out of reach of facility personnel standing on the nearest operating floor: (1) integral control station on actuator is not required; and (2) provide remotely-located control station, with pushbuttons, in accordance with this Section.
 2. Furnish electric actuator integral with valve consisting of:
 - a. Motor.
 - b. Gearing.
 - c. Handwheel.
 - d. Limit and torque switches.
 - e. Lubricants.
 - f. Heating elements.
 - g. Wiring.
 - h. Terminals for motor power and controls.
 - i. Drive nut.
 3. Housing/enclosure:
 - a. Provide cast iron gear housing and cast iron load bearing enclosure.
 - b. Non load bearing enclosure and housing: Aluminum or cast iron.
 - c. Rated for area classification shown on Drawings.
 - d. Provide O-ring seals for covers and entries.

- e. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.
4. Motors:
- a. Provide motors that are totally enclosed, high torque design made expressly for valve actuator service and capable of operating the valve under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
 - b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10% above or below rated voltage.
 - c. Provide positive method to ensure motor bearings are permanently lubricated.
 - d. Provide three thermal switches imbedded in windings:
 - 1) 120 degrees apart.
 - 2) Provide motor shutdown at high temperature.
 - e. Motor housing:
 - 1) Aluminum or cast iron.
 - 2) Totally enclosed nonventilated with cooling fins.
 - f. Provide motor capable of operating in any position.
 - g. Provide motor sealed from gearcase to allow any mounting position.
 - h. Provide motors suitable for 480 V, 3 PH, 60 Hz.
5. Gearing:
- a. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100% overload, and effectively sealed against entrance of foreign matter.
 - b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
 - c. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
 - d. Limit switch gearings and feedback device reduction gearing:
 - 1) Steel or bronze.
 - e. Support rotating shafts with anti-friction bearings.
 - f. Provide separate drive nut/thrust bearing assembly:
 - 1) Mounted to base of actuator.
 - 2) High tensile bronze.
 - 3) Quarter turn actuator: Provide 90 degrees mounting intervals.
 - 4) Provide grease fitting on drive assembly.
6. Handwheel:
- a. Permanently attached for manual operation.
 - b. Positive declutch mechanism to engage and disengage handwheel.
 - c. Handwheel shall not rotate during motor operation.
 - d. Inoperable motor shall not prevent manual operation.
7. Limit torque and thrust loads in both closing and opening directions by torque limit switches.
- a. Provide torque switches with micrometer adjustment and reference setting indicator.
 - 1) Assure adjustment variation of approximately 40% in torque setting.
 - b. Provide switches having rating of not less than 6 A at 120 VAC and 2.2 A at 115 VDC.
 - c. Limit and torque switches shall have totally sealed contacts.
8. Furnish electric actuator with two geared limit switch assemblies with each switch assembly having four separate limit switches:
- a. Assure each limit switch assembly is geared to driving mechanism and is independently adjustable to trip at any point at and between the fully open and fully closed valve position.
 - b. Provide minimum of two normally open contacts and two normally closed contacts at each end of valve travel.
 - c. Provide switches with inductive contact rating of not less than 6 A at 120 VAC, 3 A at 240 VAC, 1.5 A at 480 VAC, 2.2 A at 115 VDC and 1.1 A at 230 VDC.

- d. Limit switches shall be fully adjustable when power is applied to actuator.
 - 9. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s).
 - a. Furnish heating elements rated at 120 VAC with heaters continuously energized.
 - 10. Open-close actuator controls:
 - a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
 - b. Provide control assembly in an enclosure rated for the defined area classification.
 - c. Controls for open/close actuator:
 - 1) Provide remote pushbutton station with enclosure rated for area classification shown on Drawings with:
 - a) Open pushbutton.
 - b) Close pushbutton.
 - c) Stop pushbutton.
 - d) Remote/local switch.
 - e) Full open light.
 - f) Full close light.
 - g) Open and close relays as required.
 - 2) Provide control enclosure to accept:
 - a) Remote open/close switches.
 - 3) Provide contacts in control enclosure:
 - a) Remote/local contact.
 - b) Full open contact.
 - c) Full close contact.
 - 4) Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
 - 11. Additional requirements for modulating valve actuators:
 - a. Proportional position servo-amplifier mounted integral with the actuator control compartment.
 - b. Positioning of valve shall be proportional to a 4-20 mA signal input to the position servo-amplifier when remote control has been selected.
 - c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.
 - d. Provide 4-20 mA signal position control as shown on the Drawings that interfaces with the position control/position feedback instrumentation wiring to and from remote control device.
 - 12. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.
- D. Electric Actuators (120 V, 1 PH):
- 1. Electric Motor Actuators - General:
 - a. Provide electric motor actuators for valves and gates so indicated: on the Drawings, in valve schedule in the Specifications, or elsewhere in the Contract Documents.
 - b. Unless otherwise specified, provide each electric motor actuator with integral control devices for operation, including pushbuttons. When actuator's integral control station would be 6 feet or more above the nearest operating floor, or when integral control station would be out of reach of facility personnel standing on the nearest operating floor: (1) integral control station on actuator is not required; and (2) provide remotely-located control station, with pushbuttons, in accordance with this Section.
 - 2. General:
 - a. Self contained including motor, gearing, torque switch, limit switches and cast housing.
 - b. Electrical enclosure: NEMA 4 or NEMA 7 to comply with area rating classification shown on Drawings.

- c. Factory assembled requiring only field connection of power and control wires.
 - d. Comply with Section 01 61 03.
3. Motors:
- a. Produce 1.5 times the required torque.
 - b. Sized for two complete open-close cycles without overheating.
 - c. One fully closed to fully open cycle to occur within 60 seconds.
 - d. Class F insulation.
 - e. Operate at plus or minus 10% voltage.
 - f. 120 Volt, single phase, 60 Hz.
 - g. Provide thermal cutout switch and internal heater for actuator enclosure.
 - h. Control wiring as shown on Drawing control diagrams.
4. Remote pushbutton station:
- a. Enclosure: NEMA 4 stainless steel.
 - b. Control relays shall include:
 - 1) Open relay.
 - 2) Closed relay.
 - 3) Remote control device interface relay.
 - c. Push-to-test indicating lights shall include:
 - 1) Open.
 - 2) Closed.
 - 3) Remote.
 - d. Selector switches shall include:
 - 1) Local-Remote.
 - 2) Open-Close.
 - e. Space heater for enclosure.
 - f. Control wiring as shown on control diagrams.
 - g. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
5. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.
- E. Valve Lockout Devices:
- 1. Device manufactured from same material as valve operator, preventing access to valve operator, to accept lock shackle.

2.4 FABRICATION

- A. End Connections:
- 1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 40 05 00 or as shown on the Drawings.
 - 2. Comply with the following standards:
 - a. Threaded: ASME B1.20.1.
 - b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
 - c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
 - d. Soldered: ASME B16.18.
 - e. Grooved: Rigid joints per Table 5 of AWWA C606.
- B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.
- C. Nuts, Bolts, and Washers:
- 1. Wetted or internal to be bronze or stainless steel.
 - a. Exposed to be zinc or cadmium plated.
 - 2. Buried:
 - a. T-Bolts for mechanical joints: Per AWWA/ANSI C111/A21.1

- b. Other bolts and nuts: ASTM A193/A194 Grade B8M, Class 1.
 - c. Wax Tape Coatings per AWWA C217.
 - 3. Exposed: ASTM A193/A194 Grade B8M, Class 1.
 - 4. Heads and dimensions per ASME B1.1.
 - 5. Threaded per ASME B1.1.
 - 6. Project ends 1/4 to 1/2 inches beyond nuts.
- D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.
- E. Epoxy Interior Coating: 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: Provide manufacturer's standard coatings.
- C. Setting Buried Valves:
 - 1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
 - 2. Set valves and valve boxes plumb.
 - 3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
 - 4. Install in closed position.
 - 5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
 - 6. After installation, backfill up to top of box for a minimum distance of 4 feet 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. For grooved coupling valves, install rigid type couplings.
- F. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.
- G. Wax Tape Coating System:
 - 1. After installation, coat all buried nuts and bolts with a wax tape coating system in accordance with:
 - a. AWWA C217.
 - b. Manufacturer's printed instructions.
 - 2. Cut strips of wax tape and apply them around all bolts and nuts so that there are no voids or spaces under the tape.
 - 3. Apply a sufficient amount of tape to completely encapsulate all bare metal.
- H. For threaded valves, provide union on one side within 2 feet of valve to allow valve removal.
- I. Install valves accessible for operation, inspection, and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Wax Tape Coating Testing:
 - 1. Inspect each wax tape-wrapped component.
 - a. Verify primer was applied to substrate surfaces.
 - b. Ensure the wax tape has fully encapsulated all portions of the substrate.
 - c. Ensure that the wax tape is in intimate contact with the substrate.
 - d. Verify that the wax tape has been applied to the specified thickness.

2. Do not backfill until this inspection is complete and the wax tape application is approved by the Engineer.
- B. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by this Specification Section.
 2. Supervise pre-start adjustments and installation checks.
 3. Conduct initial start-up of equipment and perform operational checks.
 4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 75 00 on operation and maintenance of each of following valving equipment:
 5. Section 40 05 51 -Valves Basic Requirements, 4 hours.
 - a. Training shall be for electric actuators. Training associated with manually-actuated valves shall be incorporated into the following sections below.
 6. Section 40 05 64 – Butterfly Valves, 2 hours.
 7. Section 40 05 66 – Check Valves, 2 hours.

3.3 ADJUSTMENT

- A. Adjust valves, actuators, and appurtenant equipment to comply with Section 01 75 00.
1. Operate valve, open and close at system pressures.
- B. For all 120 VAC and 480 VAC electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
1. Inspect valve actuators covered by this Specification Section.
 2. Supervise adjustments and installation checks:
 - a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
 - b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
 - c. Simulate a valve position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
 3. Provide Owner with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.

3.4 ACTUATED VALVE SCHEDULE

- A. Unless shown otherwise on Drawings and drawing schedules, provide electrically-actuated valves as follows:

Valve Tag	Service ¹	Type	Size (dia), Inches	Voltage / Phase ²	Open / Close or Modulating ³	Comment
BFV-30(x)	ALP	Butterfly	6	480	O/C	AB3 C1
BFV-30(x+1)	ALP	Butterfly	8	480	MOD	AB3 C2
BFV-30(x+2)	ALP	Butterfly	8	480	MOD	AB3 C3
BFV-30(x+3)	ALP	Butterfly	6	480	O/C	AB4 C1
BFV-30(x+4)	ALP	Butterfly	8	480	MOD	AB4 C2
BFV-30(x+5)	ALP	Butterfly	8	480	MOD	AB4 C3

1. Service defined in section 40 05 00.
2. 480 = 480V, 3P, 60 HZ; 120 = 120V, 1P, 60 HZ; electric actuators only
3. O/C = Open/Close, MOD = modulating

3.5 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

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SECTION 40 05 64
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. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 - 2. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.
 - 2. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - c. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - e. A436, Standard Specification for Austenitic Gray Iron Castings.
 - f. A536, Standard Specification for Ductile Iron Castings.
 - 3. American Water Works Association (AWWA):
 - a. C504, Standard for Rubber-Seated Butterfly Valves.
 - 4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-67, Butterfly Valves.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 40 05 51.
 - 2. For valves 8 inches and larger, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. DeZurik.
 - 2. Mueller/Linseal.
 - 3. Pratt (a Mueller brand).
 - 4. Bray.

2.2 HIGH PERFORMANCE BUTTERFLY VALVES

- A. In locations where reliability is critical, for automated valves that modulate for flow control or actuate periodically in intervals less than 2 hours, high performance butterfly valves with an offset disc design shall be used.
 - 1. See actuated valve schedule on Drawings for valves specified to be high performance butterfly valves.
- B. Design Requirements:
 - 1. One-piece shaft.
 - 2. Separate shaft seal.
 - 3. Minimum shaft diameter to conform to AWWA C504, Class 150B.
- C. Materials of construction:
 - 1. Disc: 316 stainless steel.
 - 2. Shaft and pins: 17-4PH stainless steel or 316 stainless steel.
 - 3. Seals:
 - a. Water: PTFE.
 - b. Process air and high temperature: Graphite rings.
 - 4. Backing ring: Stainless steel.
 - 5. Bushings/Bearings: TFE/Glass liner with a 316 Stainless steel shell.
 - 6. Seat:
 - a. Two part with encapsulated RTFE or PTFE.
 - b. Seat Retainer: Stainless Steel.
 - c. Or Stainless Steel.
 - 7. End connection: Lugged valves may be used.

2.3 GENERAL USE BUTTERFLY VALVES

- A. For use in all locations, except where high performance butterfly valves are required.
- B. Comply only with AWWA C504, as noted in this Specification Section.
- C. Materials:
 - 1. Valve bodies:
 - a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
 - b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
 - 2. Valve shafts:
 - a. One-piece stainless steel, Type 304.
 - b. Pins: 304 stainless steel.
 - c. Bushings/Packing/O-rings:
 - 1) Wastewater: Buna-N or Viton.
 - 2) Process air: EPDM, RTFE or TFE.
 - d. Bearings: Reinforced TFE or equal.
 - 3. Valve discs:
 - a. Cast iron with welded nickel edge or 304 Stainless Steel disk.
 - 4. Valve seats:
 - a. Wastewater: Buna-N or Viton.
 - b. Process air: EPDM, rated for up to 250DEGF.
 - 5. Shaft bearing: Bronze, TFE-coated stainless steel or reinforced TFE.
 - 6. Shaft seal in addition to any sealing provided by seat: Suitable synthetic rubber rings or PTFE V-ring suitable for operating conditions.
- D. Design Requirements:
 - 1. Seat type: Resilient.
 - 2. Body type:
 - a. Wafer Lug (laying length may vary from AWWA C504).
 - b. Equip wafer type with fully tapped anchor lugs drilled per ASME B16.5.
 - 3. Shaft diameter: One-piece constant diameter.

2.4 ACCESSORIES

- A. Refer to Drawings and/or valve schedule for type of actuators.
 - 1. Furnish actuator integral with valve.
- B. Refer to Section 40 05 51 for actuator requirements.
- C. Valve Flange Seal Rings:
 - 1. If Steel Slip-on flanges are being used on the process piping, flange seals will be required for proper installation of valves.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Section 40 05 51.

END OF SECTION

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SECTION 40 05 66
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Swing check valves, three-inch to 24-inch diameter.
- B. Related Requirements: Include but are not necessarily limited to:
 - 1. Section 40 05 51 - Valves - Basic Requirements.

1.2 REFERENCES

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. American Water Works Association (AWWA):
 - a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 inches through 24 inches NPS.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - b. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Valve Manufacturers:
 - a. Manufacturer shall be a business regularly engaged in manufacturing and furnishing check valves of the type required and similar equipment.
 - b. Manufacturer shall be able to document having furnished not less than 50 check valves, of the type required, of size equal to or larger than those required for the Work, during the past five years.
 - c. When requested by Engineer, submit qualifications statement indicating manufacturer's record of manufacturing and furnishing check valves of the types and sizes required and furnish documentation of compliance with qualifications requirements of this Article.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. In accordance with Section 40 05 51 - Valves Basic Requirements.
- B. Informational Submittals: Submit the following:
 - 1. In accordance with Section 40 05 51 - Valves Basic Requirements.
 - 2. Manufacturer's Instructions:
 - a. Manufacturer's written instructions for delivery, handling, storage, installation, and startup.
- C. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23 - Operations and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES: 3 INCHES TO 24 INCHES

- A. Swing Check Valves (Water, Wastewater, Sludge):

1. Comply with AWWA C508.
2. Manufacturers:
 - a. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1) Clow.
 - 2) America Darling.
 - 3) GA Industries.
3. Materials:
 - a. Body and cover: Cast iron.
 - b. Seat ring, hinge: Bronze.
 - c. Disc:
 - 1) 3 to 4 inches: Bronze.
 - 2) 6 to 24 inches: Cast iron with rubber face.
 - d. Hinge shaft: Stainless steel.
 - e. Bearings, connecting hardware: Bronze.
4. Design requirements:
 - a. 175 psi working pressure (3 to 12 inches).
 - b. 150 psi working pressure (14 to 24 inches).
 - c. Furnish with outside weight and lever.
 - d. Use for wastewater in a vertical installation.

2.2 SOURCE QUALITY CONTROL

- A. Factory Tests and Inspections:
 1. Perform manufacturer's standard factory tests and inspections on materials and equipment furnished. Correct defects prior to shipment to the Site.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation – General:
 1. Provide check valves at locations shown and indicated in the Contract Documents.
 2. Install in accordance with the Contract Documents and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions, obtain written interpretation or clarification from Engineer.
 3. Comply with:
 - a. Section 01 61 03 - Equipment - Basic Requirements.
 - b. Section 40 05 51 - Valves - Basic Requirements.
 - c. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 4. Before installing, ensure each check valve is clean and free of dirt and debris.

3.2 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
 1. Promptly after installing, before installing connecting pipe, verify proper and free operation of check valve.
 2. Hydrostatically test check valves together with associated piping.
 3. To extent practical, prior to Substantial Completion, verify proper operation of each installed check valve.

END OF SECTION

SECTION 40 42 00
PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation:
 - a. Piping insulation.
 - 2. Adhesives, mastics, sealants, and finishes.
 - 3. Grease and air ventilation duct wrap fire protection systems.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 40 05 07 - Pipe Support Systems.

1.2 ABBREVIATIONS:

- A. MLV: Mass loaded vinyl.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
 - 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. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - e. C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - f. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - h. E96, Standard Test Methods for Water Vapor Transmission of Materials.
 - i. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas.
 - j. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - l. E119 Standard Method of Fire Tests of Building Construction, 2 Hour Wall Panel Test, 2 Hour External Total Engulfment Test, hose stream evaluation.
 - m. E136, Combustion Characteristics of Building Materials in a Vertical Tube Furnace.
 - n. E162, Surface Flammability of Materials.
 - o. E814, Through-Penetration, 2-Hour Firestop Test.
 - p. E2336: Standard Test Methods Fire Resistive Grease Duct Enclosure Systems.
 - 2. ISO 6944-1985, Method of Determining Fire Resistance of Ventilation Ducts.
 - 3. National Fire Protection Association (NFPA):
 - a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
 - 5. National Commercial and Industrial Insulation Standards (2013 seventh edition).
 - a. Published by Midwest Insulation Contractors Association (MICA).

- b. Endorsed by National Insulation Association (NIA).
- c. MICA plate numbers listed in this specification reference this document.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
 - 2. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
 - 3. Certifications: Products will meet the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Fiberglass insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Owens Corning.
 - d. Knauf.
 - 2. MLV acoustic barrier:
 - a. Kinetics Noise Control (KNM-200AL).
 - b. Or approved equal.
 - 3. High density perlite:
 - a. Johns Manville.
 - b. Industrial Insulation Group (LIC).
 - 4. High density calcium silicate:
 - a. Industrial Insulation Group (LIC).
 - 5. Adhesives, mastics, sealants, and finishes:
 - a. Foster Products.
 - b. Childers.
 - c. Dow Corning.
 - d. Johns Manville.
 - e. Knauf.

2.2 PIPING INSULATION - FIBERGLASS

- A. Pipe and Fitting Insulation:
 - 1. Preformed fiberglass pipe insulation:
 - a. Density: 4 pounds/CUFT.
 - b. Temperature rated: 650 degrees F.
 - c. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT²-DEGF) at mean temperature of 75 degrees F.
 - d. Fire hazard rating:
 - 1) UL 723, ASTM E84, NFPA 255.
 - 2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
 - 2. Moisture adsorption:
 - a. ASTM C553.
 - b. Not greater than 5% moisture by volume when exposed to moisture laden air at 120 degrees F and 96% 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. MLV acoustic barrier (secondary service as piping jacket):
 - a. Reinforced aluminum foil facing.
 - b. Barrier shall have a nominal density of 2.0 pounds per square foot with 0.24-inch thickness.
 - c. Flame spread index: 25 or less per ASTM E84-15b.
 - d. Smoke development index: 450 or less per ASTM E84-15b.
 - e. Service temperature: -40 degrees F to 220 degrees F.
 - f. Minimum sound transmission loss, tested as free hanging barrier per ASTM E90-09:

Frequency (Hz)	125	250	500	1,000	2,000	4,000	STC
Losses (dB)	21	22	27	32	37	42	31

5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.3 PIPE INSULATION INSERTS AT HANGERS

- A. High Density Perlite:
 1. Pre-formed.
 2. Fire hazard rating:
 - a. UL 723, ASTM E84, NFPA 255.
 - b. Flame spread: Zero.
 - c. Smoke developed: Zero.
 3. Average density: 13 pounds/CUFT.
 4. Compressive strength: 80 psi to produce 5% compression.
 5. Maximum surface temperature: 1,200 degrees F.
- B. High Density Calcium Silicate:
 1. Pre-formed.
 2. Fire hazard rating:
 - a. UL 723, ASTM E84, NFPA 255.
 - b. Flame spread: Zero.
 - c. Smoke developed: Zero.
 3. Average density: 14 pounds/CUFT.
 4. Compressive strength: 100 psi to produce 5% compression.
 5. Maximum surface temperature: 1,200 degrees F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. General:
 1. Piping below ground covered with earth will not be insulated except as specified in Specification Section 40 05 25.
 - a. Only exposed piping will be wrapped with fiberglass insulation and MLV.
 - 1) MLV shall be installed exterior to fiberglass insulation and shall also serve as insulation jacket.
 2. Consider piping as exposed, except as otherwise indicated.
 3. Consider piping in walls, partitions, floors, pipe chases, pipe shafts and duct shafts as concealed.
 - a. Consider piping above ceilings as concealed.
 4. Provide release for insulation application after installation and testing is complete.

- a. Apply insulation on clean, dry surfaces after inspection.
 - 5. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
 - 6. Provide insulation with vapor barrier for piping where surfaces may be cooler than surrounding air temperatures.
 - a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
 - b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
 - 7. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.
- C. Piping Insulation - Fiberglass:
- 1. Apply over clean dry pipe.
 - a. Butt all joints together firmly.
 - 2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
 - 3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
 - 4. PVC pipe jacket:
 - a. Apply jacketing with a minimum of 1 inch overlap.
 - 1) Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.
 - b. Provide slip-joints every 30 feet and between fittings if distance exceeds 8 feet.
 - 1) Construct slip-joints by overlapping jacket sections 6 to 10 inches.
 - c. Provide pre-molded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.
 - 5. MLV acoustic barrier:
 - a. Field-applied acoustic barrier with vapor-sealed longitudinal and butt joints.
 - b. Provide smooth and straight joint with a minimum 2 inches overlap.
 - c. Secure joints with acoustical barrier tape.
 - d. 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.

3.3 SCHEDULES

- A. Pipe, Fittings and Valves:
 - 1. Fiberglass.

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Low Pressure Air	2-1/2 to 6 inches	1/2 inches	MLV
	Over 6 inches	2 inches	MLV

END OF SECTION

SECTION 40 75 00
PROCESS LIQUID ANALYTICAL MEASUREMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nitrate Analyzer.
 - 2. Dissolved Oxygen Sensor and Analyzer.
 - 3. ORP Sensor and Analyzer.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 40 90 05 - Control Loop Descriptions.

1.2 QUALITY ASSURANCE

- 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SYSTEM DESCRIPTION

- A. These instruments are integrated with other control system components specified to produce the functional control defined in the Contract Documents.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 ANALYTICAL ELEMENTS

- A. Dissolved Oxygen Sensor and Analyzer:
 - 1. Manufacturers:
 - a. Hach Company, model LDO-2 sensor and model sc4500 controller (transmitter).
 - b. Endress + Hauser: Oxymax COS61 series sensor and Liquiline CM442 series transmitter.
 - 2. Materials:
 - a. Sensor wetted parts: Noryl, Teflon, 316 stainless steel, PVC, polypropylene, PBT (thermoplastic polyesters based on polybutylene terephthalate), or PC (polycarbonate).
 - b. Sensor membrane: Polybutyl methoacrolate or Teflon.
 - c. If amperometric type sensor:
 - 1) Anode: Silver.

- 2) Cathode: Gold.
3. Design and fabrication:
 - a. Sensor:
 - 1) Utilize digital sensor capable of being calibrated with a lab analyzer and then connected to a second analyzer in the field without the need to recalibrate.
 - 2) Temperature compensated.
 - 3) Inaccuracy:
 - a) Dissolved oxygen: ± 0.2 PPM or $\pm 0.2\%$ of span at calibrating temperature.
 - b) Temperature: ± 0.5 degrees C.
 - 4) Response time: 95% in 60 seconds.
 - 5) Internal calibration standard.
 - 6) Mounting: Per schedule below.
 - 7) Operating temperature: 32 to 104 degrees F.
 - 8) Spares:
 - a) Luminescent type sensors: One replacement sensor cap per sensor installed.
 - b) Electrochemical type sensors: One replacement sensor per each two (or fraction thereof) sensors installed.
 - 9) A retractable system for mounting shall be provided for installation in open basins, channels and tanks.
 - b. Controller (analyzer/transmitter):
 - 1) Capable of receiving inputs from two sensors.
 - 2) Minimum 2-1/2 digit local LED or backlit LCD display.
 - a) 0.1 PPM resolution.
 - b) 0.1 degrees F resolution.
 - c) Menu driven.
 - d) Indication of sensor fault condition.
 - 3) Power supply: 120VAC.
 - 4) Output signals:
 - a) Quantity: Two (one per sensor).
 - b) Isolated (2) 4-20 mA DC, dissolved oxygen, into 500 ohms.
 - c) Digital Communication: Ethernet/IP
 - 5) Operating temperature: 0 to 140 degrees F.
 - 6) Relative humidity: 95%.
 - 7) Provide with manufacturers sunshield when mounted outdoors.
 - 8) Mounting: Per schedule below.
4. Schedule:

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING	MOUNTING TYPE
AE-307	BASIN 3 ZONE 1	0-100mg/L	IP68	SENSOR – IMMERSION
AIT-307	BASIN 3 ZONE 1	CONTROLLER / TRANSMITTER	IP66	TRANSMITTER - HANDRAIL
AE-308	BASIN 3 ZONE 2	0-100mg/L	IP68	SENSOR – IMMERSION
AIT-308	BASIN 3 ZONE 2	CONTROLLER / TRANSMITTER	IP66	TRANSMITTER - HANDRAIL
AE-309	BASIN 3 ZONE 3	0-100mg/L	IP68	SENSOR – IMMERSION
AE-310	BASIN 4 ZONE 1	0-100mg/L	IP68	SENSOR – IMMERSION
AIT-310	BASIN 4 ZONE 1	CONTROLLER / TRANSMITTER	IP66	TRANSMITTER - HANDRAIL
AE-311	BASIN 4 ZONE 2	0-100mg/L	IP68	SENSOR – IMMERSION
AIT-311	BASIN 4 ZONE 2	CONTROLLER / TRANSMITTER	IP66	TRANSMITTER - HANDRAIL
AE-312	BASIN 4 ZONE 3	0-100mg/L	IP68	SENSOR – IMMERSION

**Install with manufacturer's standard sunshade

B. ORP Sensor and Analyzer:

1. Manufacturers:
 - a. Hach DRD1P5 sensor, digital gateway 6120500, and sc4500 controller (transmitter).
 - b. Endress + Hauser: CPF82E series sensor with Memosens technology and Liquiline CM442 series transmitter.
2. Materials:
 - a. Body, cover: Polyethersulfone (PES), Kynar (PVDF), liquid crystal polymer, epoxy (less than 140F), or equal.
 - b. O-rings: VITON.
3. Design and fabrication:
 - a. Integral pre-amplifier to convert high impedance ORP measurement into stable, noise-free signal (if not furnished with integral transmitter).
 - b. Automatic temperature compensation.
 - c. Shielded cable.
 - d. Include a titanium ground electrode to eliminate ground loop currents in the measuring electrodes.
 - e. Sensitivity: $\pm 0.5\text{mV}$.
 - f. Range: -1500 mV to +1500 mV.
 - g. Stability: 2 mV per 24 hours.
 - h. A retractable system for mounting shall be provided for installation in open basins, channels and tanks.
 - i. Transmitter:
 - 1) Local digital display.
 - a) LCD or LED.
 - b) Minimum 3-1/2 digit.
 - 2) Power supply: 120 VAC.
 - 3) Ambient temperature: - 4 to 122 degrees F.
 - 4) Ambient humidity: 0-95%.
 - 5) Temperature compensated.
 - 6) Output signal: 4-20 mA.
 - 7) Communications: Ethernet/IP
 - j. Provide manufacturers sunshield
4. Schedule:

TAG NUMBER	SERVICE	SPAN	NEMA RATING	SENSOR MOUNTING TYPE
AE-315	BASIN 3 ZONE 1	-1500mV-1500mV	IP68	SENSOR – IMMERSION
AE-316	BASIN 4 ZONE 1	-1500mV-1500mV	IP68	SENSOR – IMMERSION

C. Nitrate Analyzer

1. Manufacturers:
 - a. Hach NT3100sc sensor and model sc4500 controller (transmitter).
 - b. Endress and Hauser ISEmax CAS40D sensor with Memosens technology and Liquiline CM442 series transmitter.
2. Design and Fabrication
 - a. Sensor
 - 1) Measuring variables: $\text{NO}_3\text{-N}$, NO_3 .
 - 2) Measurement Ranges:
 - a) 0.1 to 50mg/l or 0.4 to 200mg/l NO_3 for clear water + activated sludge
 - b) .01 to 20 mg/l $\text{NO}_3\text{-N}$ or 0.04 to 80 mg/l NO_3 for clear water up a turbidity of 50 FNU.
 - c) 0.1 to 50 l/M; 0.5 to 250 l/m or 1.5 to 700 l/m SAC

- d) d. 0.15 to 75 mg/l; 0.75 to 370 mg/l; 2.5-1000 mg/l equivalent KHP for COD.
 - e) e. 0.06 to 30 mg/l; 0.3-150 mg/l; 0.9-410 mg/l equivalent KHP for TOC
 - 3) Maximum measured error (nitrate):
 - a) For 0.1 to 50 mg/l NO₃-N (2 mm cuvette gap): ±0.2 mg/l below 10 mg/l 2 % of full scale value above 10 mg/l.
 - b) For 0.01 to 20 mg/l NO₃-N (8 mm cuvette gap): ±0.04 mg/l below 2 mg/l 2 % of full scale value above 2 mg/l
 - 4) Repeatability (nitrate): Min. ±0.2 mg/l NO₃-N
 - 5) Drift (nitrate): less than 0.1 mg/L NO₃-N per week
 - 6) Environment
 - a) Ambient temperature: -20 to 60 °C (-4 to 140 °F).
 - b) Storage temperature: -20 to 70 °C (-4 to 158 °F).
 - c) Process temperature: +5 to 50 °C (41 to 120 °F).
 - d) Ingress protection: IP68.
 - e) Process pressure: 0.5 to 10 bar (7 to 145 psi) absolute
 - 7) No chemicals or reagents are needed
 - 8) Factory calibrated with certificate
 - 9) A retractable system for mounting shall be provided for installation in open basins, channels and tanks.
- b. Transmitter
- 1) Shall be multi-parameter controller with up to four measuring channels based on digital technology.
 - 2) Power supply: 120 VAC.
 - 3) Programmed computations and features resident in nonvolatile memory.
 - 4) Transmitter firmware shall be upgradeable in the field by the user of factory technician without removing the transmitter from service.
 - 5) Transmitter shall be available in a IP66/NEMA 4X field housing with integral display.
 - 6) Digital communications for plug and play for all sensor configurations.
 - 7) Output: 4-20mA, relay outputs
 - 8) Communications: Ethernet/IP
 - 9) Option for integral web server
3. Schedule:

TAG NUMBER	SERVICE	NEMA RATING	SENSOR MOUNTING TYPE
AE-319	BASIN 3 ZONE 1	IP68	SENSOR – IMMERSION
AIT-319	BASIN 3 ZONE 1	IP66	TRANSMITTER - HANDRAIL
AE-320	BASIN 4 ZONE 1	IP68	SENSOR – IMMERSION
AIT-320	BASIN 4 ZONE 1	IP66	TRANSMITTER - HANDRAIL

2.3 ACCESSORIES

- A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
- 1. Materials, unless otherwise specified, shall be as follows:
 - a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
 - b. Mounting brackets:
 - 1) Standard: 316 stainless steel.
 - 2) Highly corrosive areas: Aluminum.
 - c. Mounting plates, angles:
 - 1) Standard: Carbon steel.

- 2) Corrosive areas: 316 stainless steel.
 - d. Instrument pipe stands:
 - 1) Standard: Hot-dip galvanized 2 inches schedule 40, ASTM A106, Grade B carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
- B. Tubing Support Angles and Brackets:
 - 1. Any of the following materials are acceptable:
 - a. Aluminum support with dielectric material between support and tubing.
 - b. Type 316 stainless steel.
 - c. Fiberglass.
- C. Tubing Tray or Channel:
 - 1. Aluminum.
 - 2. Provide dielectric material between tray or channel and tubing.
- D. Provide handheld communicator compatible with all intelligent transmitters furnished.
 - 1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
 - 2. If these features are provided with the intelligent transmitter, the hand held communicator is not required (provided the transmitter is easily accessible by an operator without the need for a ladder/step stool).
- E. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install instrument mounting pipe stands level and plumb.
- C. Instrument Mounting:
 - 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
 - 2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
 - 3. Mount instruments level, plumb, and support rigidly.
 - 4. Mount to provide:
 - a. Protection from heat, shock, and vibrations.
 - b. Accessibility for maintenance.
 - c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

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SECTION 40 90 00

INSTRUMENTATION FOR PROCESS CONTROL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Basic requirements for complete instrumentation system for process control.
 2. Requirements for construction sequencing and scheduling of additions and modifications of controls equipment.
 3. Requirements for coordination of Testing, Programming and Startup Activities.
 - a. Programming shall be provided by the programming and integration Contractor.
 - b. The Programmer shall assist the Contractor with Startup Activities. The Contractor shall be prepared to make adjustments and modifications to meet the designed system operational requirements.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 10 14 00 - Identification Devices.
 4. Section 26 05 00 – General Requirements for Electrical Work.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Canadian Standards Association (CSA).
 2. FM Global (FM).
 3. The International Society of Automation (ISA):
 - a. 7.0.01, Quality Standard for Instrument Air.
 - b. S5.1, Instrumentation Symbols and Identification.
 - c. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 6. National Institute of Standards and Technology (NIST).
 7. Underwriters Laboratories, Inc. (UL):
 - a. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.
- B. Qualifications:
1. Instrumentation subcontractor:
 - a. Experience:
 - 1) Have satisfactorily provided a control system for a minimum of five (5) projects of similar magnitude and function.
- C. Miscellaneous:
1. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

1.3 DEFINITIONS

- A. Architecturally finished area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
- B. Non-architecturally Finished Area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

- C. Hazardous Areas: Class I, II or III areas as defined in NFPA 70.
- D. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
- E. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
- F. Instrument Air Header: The segment of air supply piping and tubing which transports air from the compressed instrument air source through the branch isolation valve of any takeoff (branch) line.
- G. Branch Line: The segment of air supply piping and tubing which transports air from the outlet of the air header branch isolation valve through an air user's isolation valve.
- H. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.
- I. Calibrate: To standardize a device so that it provides a specified response to known inputs.

1.4 SYSTEM DESCRIPTION

- A. Control System Requirements:
 - 1. This Specification Section provides the general requirements for the instrument and control system.
 - 2. The instrument and control system consists of all primary elements, transmitters, switches, controllers, computers, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, wiring, and other devices required to provide complete control of the plant as specified in the Contract Documents.
 - 3. The existing Process Instrumentation and Control Systems (PICS) design and associated native Ethernet IP network protocol is based on the existing plant Rockwell Automation platform. Network standardization is required to maximize operational efficiency and effectiveness, and minimize network operational costs.
 - a. All new equipment connected to PICS via Ethernet shall utilize native Ethernet IP protocol. The term “native” used in this context means that the protocol is integral to the equipment—a converter or gateway to convert from one protocol to another (e.g., Modbus Plus to Ethernet IP) is not required. *The use of protocol converters and gateways for substitute equipment is not acceptable.*
 - b. All proposals for substitute products shall demonstrate equipment compatibility with existing software and hardware systems, replacement parts requirements, and training requirements. The bid price of the proposed substitute products shall include:
 - 1) 8 hours of training (in addition to that specified herein) for Owner operations personnel
 - 2) Spare parts (for each type/size) including control and power boards or modules, operator interface units, and communication and input/output modules
 - 3) PICS modification design, programming, and integration costs required to accommodate the proposed substitute.
 - 4.
- B. All signals shall be directly linearly proportional to measured variable unless specifically noted otherwise.
- C. Single Instrumentation Subcontractor(s):
 - 1. With the exception of Programming the instrumentation system shall be furnished and coordinated through a single instrumentation subcontractor.

- a. The instrumentation subcontractor shall be responsible for functional operations of all systems, verification of all instrumentation to meet requirements in design documents, supervision of installation, final connections, calibrations, preparation of Drawings and Operation and Maintenance Manuals, start-up, training, demonstration of substantial completion and all other aspects of the control system.
2. Ensure coordination of instrumentation with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.
3. Existing equipment is in place. The Subcontractor shall ensure a fully coordinated interface of new and existing equipment, instrumentation and controls.
 - a. All costs associated with this Work shall be incorporated into the original bid.
 - b. Although such Work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

1.5 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.
 2. Limit the scope of each submittal to one (1) Specification Section.
 - a. Each submittal must be submitted under the Specification Section containing requirements of submittal contents.
 - b. Do not provide any submittals for Specification Section 40 90 00.
 3. Product technical data including:
 - a. Equipment catalog cut sheets.
 - b. Instrument calibration data.
 - c. Instrument process connections.
 - d. Materials of construction.
 - e. Minimum and maximum flow ranges.
 - f. Pressure loss curves.
 - g. Physical limits of components including temperature and pressure limits.
 - h. Size and weight.
 - i. Electrical power requirements and wiring diagrams.
 - j. NEMA rating of housings.
 - k. Submittals shall be marked to show exact features to be provided.
 4. Drawings as specified in Specification Section 40 98 00.
 5. Where Wiring Schematics, Panel Layouts, and Bill of Materials are included as part of the Contract Documents, they are included to show design intent of system operation. The Contractor shall provide a complete and operational system. All required additions and changes to the Contract Documents shall be submitted with Shop Drawings. All as-built information/corrections shall be submitted to the Engineer to revise the original Contract Documents.
 6. All Shop Drawings shall be modified with as-built information/corrections.
 7. Drawings, systems, and other elements are represented schematically.
 - a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.
 8. All panel and wiring drawings shall be provided in both hardcopy and softcopy.
 - a. Furnish electronic files on CD-ROM or DVD-ROM media.
 - b. Drawings in AUTO CAD format.
 9. Provide a parameter setting summary sheet for each field configurable device.
 10. Certifications:
 - a. Documentation verifying that calibration equipment is certified with NIST traceability.

- b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA.
 - 1) Certification documentation is required for all equipment for which the specifications require independent agency approval.
- 11. Testing reports: Source quality control reports.
- B. The Contractor shall submit a plan to the Owner and Engineer for the replacement of existing PLC, PLC I/O and associated equipment with effort to minimize frequency and duration of plant and equipment shut down.
 - 1. The Contractors plan shall include:
 - a. A chronological outline of tasks.
 - b. An estimated time to complete each task.
 - c. Required downtimes and estimated durations.
 - d. Required interactions with Owner for manual operation of plant processes.
 - e. Required interactions with Programmer for PLC programming deployment and modifications.
 - f. Installation and removal of temporary supports, enclosures, equipment and components.
 - g. Communication and network shutdowns, cutovers and modifications.
 - h. Startup, turn-on, and automatic control of plant equipment.
 - i. Testing
- C. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - 2. Warranties: Provide copies of warranties and list of factory authorized service agents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

1.7 SITE CONDITIONS

- A. Unless designated otherwise on the Drawings, area designations are as follows:
 - 1. Outdoor area:
 - a. Wet.
 - b. Corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
 - c. Below grade vaults and manholes:
 - 1) Subject to temporary submergence when specifically designated on the Drawings or Specifications.
 - 2. Architecturally finished area:
 - a. Dry.
 - b. Noncorrosive unless designated otherwise on the Drawings or in the Specifications.
 - c. Nonhazardous unless designated otherwise on the Drawings or in the Specifications.
 - 3. Non-architecturally finished area: As designated elsewhere on the Drawings or in the Specifications.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate process control equipment installation with other process components.
- B. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Sequence, coordinate, and install the process control system materials and equipment for efficient flow of the Work.

- D. The Contractor shall coordinate with plant Operators and personnel for the replacement and addition of new PLC and communications hardware and components.
- E. The Contractor shall be responsible for all temporary supports, enclosures, equipment, and materials required to maintain plant operations and safety during construction.
- F. The Contractor shall coordinate with the Owner and Engineer to ensure that the programming is completed and ready to be quickly deployed to minimize downtime during cutover and installation of new PLC and communications hardware and components.
- G. The Contractor shall coordinate Testing, and Startup Activities through the Owner.
 - 1. The Programmer shall be notified of readiness of wiring and equipment for I/O loop testing a minimum of four (4) weeks prior to the scheduled date.
 - 2. The Engineer and Owner shall be notified and given the option to attend I/O loop verification or Control System Functional verification activities.
 - 3. The Contractor shall coordinate any manufacturer's representatives to be present as required during these periods.
- H. The Contractor shall complete system I/O loop testing as outlined in the Specification Section and provide documentation of results. Upon completion of I/O loop testing, any remaining programming and startup items shall be completed. Upon readiness of programming and startup items, Control System Functional testing shall be performed. And documented.
- I. Submit I/O loop and Control System Functional testing documentation to the Engineer for review.
- J. Testing, Programming and Startup Activities may be completed at different times for different isolated systems.

PART 2 - PRODUCTS

2.1 NEMA TYPE REQUIREMENTS

- A. Provide enclosures/housing for control system components in accordance with the following:
 - 1. Areas designated as wet: NEMA Type 4.
 - 2. Areas designated as outdoor and/or corrosive: NEMA Type 4X.
 - 3. Areas designated as Class I hazardous, Groups A, B, C, or D as defined in NFPA 70:
 - a. NEMA Type 7 unless all electrical components within enclosure utilize intrinsically safe circuitry.
 - 1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.
 - 4. Areas designated as Class II hazardous, Groups E, F, or G as defined in NFPA 70:
 - a. NEMA Type 9 unless all electrical components within enclosure utilize intrinsically safe circuitry.
 - 1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.
 - 5. Either architecturally or non-architecturally finished areas designated as dry, noncorrosive, and nonhazardous: NEMA Type 12.
 - 6. Areas designated to be subject to temporary submersion: NEMA 6P.

2.2 ACCESSORIES

- A. Provide identification devices for instrumentation system components in accordance with Specification Section 10 14 00.
- B. Provide corrosion resistant spacers to maintain 1/4 IN separation between equipment and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Clarifiers, Digesters, Reservoirs, etc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wherever feasible, use bottom entry for all conduit entry to instruments and junction boxes.
- B. Install electrical components per the requirements of the Electrical design.
- C. Panel-Mounted Instruments:
 - 1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
 - 2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.
- D. See Specification Section 26 05 19.

3.2 FIELD QUALITY CONTROL

- A. I/O Loop Testing shall be completed by the Contractor prior to Programming Activities. I/O Loop testing, at a minimum, shall include the following:
 - 1. Verification of continuity of all control circuits prior to connection to power.
 - 2. Verification and documentation that all control panels are installed, connected to power, and fully wired for all I/O points shown on the Drawings.
 - 3. Verification and documentation that all panels and devices capable of being powered have had power cycled (on-off-on) and are functional.
 - 4. Verification and documentation that all field instruments are installed, wired, and powered.
 - 5. In conjunction with the Programming Contractor check control circuit signal generation, transmission, and reception for all control circuits.
 - a. Digital instruments and switches should be tested by exercising the field device and verifying that an appropriate change in signal is received. Document the results of the test.
 - 1) Use actual signals where possible.
 - 2) Simulated conditions may be utilized by imposing a signal on the circuit at the field device or instrument connections.
 - b. Analog instruments shall be verified for proper current /voltage range received at the control panel from the field device. Document the results of the tests.
 - 1) Use actual signals where possible.
 - 2) Simulated conditions may be utilized by imposing a signal on the circuit at the field device or instrument connections.
 - c. Digital control elements shall be tested by closing the circuit in the process control panel. The proper response should be observed and verified at the field device. Document the results of the tests.
 - d. Analog control elements should be tested using a simulated source. An appropriate response should be observed and verified at the field device. Document the results of the tests.
 - e. Any I/O point that is not tested shall be documented as well as the reason for not being tested.
 - f. Testing shall be performed without unwiring and rewiring when possible.
 - 6. Operate all motors and drives from local control stations to verify functionality. Results of the test shall be documented.
 - 7. Operate control valves and solenoid valves to verify control action. Verify flow and shutoff. Verify visual position indication.
 - 8. Verify existence and measure adequacy of all grounds required for instrumentation and controls.
 - 9. Provide verification of system assembly, power, ground, and I/O tests.
 - 10. Verify that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.

- a. Each instrument shall be provided with a calibration certificate indicating the measured error (percent deviation).
 - b. Instruments that are not provided with factory calibration certificates shall be field calibrated.
 - c. Calibrate all field-mounted instruments, other than local pressure and temperature gages, after the device is mounted in place to assure proper installed operation.
 - d. Calibrate in accordance with the manufacturer's specifications.
 - e. Bench calibrate pressure and temperature gages.
 - a) Field mount gage within seven (7) days of calibration.
 - f. Replace any instrument which cannot be properly adjusted.
 - g. Calibration equipment shall be certified by an independent agency with traceability to NIST.
 - 1) Certification shall be up-to-date.
 - 2) Use of equipment with expired certifications shall not be permitted.
 - h. Calibration equipment shall be at least three (3) times more accurate as the device being calibrated.
11. Verify all equipment, conduit, and instrument tagging is in place and accurate according to Identification Devices Specification.
- B. Functional Testing shall be completed by the Programming Contractor and shall demonstrate that the instrumentation and control system complies with all contract requirements. Functional Testing shall demonstrate proper operation of all process systems provided under this contract with process equipment operating over full operating ranges and under actual operating conditions. Functional testing, at a minimum, shall include the following:
1. Functional testing shall verify the completeness of the Programming.
 2. Check control circuit signal generation, transmission, reception and response for all control circuits under operating conditions.
 - a. All I/O points shall be tested. The results of the test shall be documented.
 - b. Closely observe indicators, transmitters, and other control components.
 - 1) Verify that readings at all loop components are in agreement.
 - 2) Make corrections as required.
 - a) Following any corrections, retest the loop as before.
 3. When possible, the Programming Contractor shall create actual process events and verify proper system response during testing.
 4. All Alarm conditions shall be tested and verified that alarms are generated. Document the results.
 5. The touch screen Operator Interface shall be capable of system navigation and adjustment of all Operator adjustable set points.
 6. Operate all control valves, motors and drives from the operator interface. Verify and document the results.
 7. Verify and document the calibration of each transmitter and gage across its specified range at 0, 25, 50, 75, and 100 percent.
 - a. Check for both increasing and decreasing input signals.
 8. Check all interlocks to the maximum extent possible.
 9. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.
- C. Maintain accurate log of all Testing and Startup Activities, calibration functions, and final setpoint adjustments. Submit with closeout documentation.

END OF SECTION

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SECTION 40 90 05
CONTROL LOOP DESCRIPTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment and instrumentation control loops.
- B. SCADA configuration and integration services will be provided by Banyan Technologies as described in Section 01 11 00 – Summary of Work.
 - 1. This Section is included in Project Manual for reference only.
- C. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 90 00 - Instrumentation for Process Control: Basic Requirements.

1.2 QUALITY ASSURANCE

- A. See Specification Section 40 90 00.

1.1 DEFINITIONS

- A. PLC - Programmable Logic Controller.
- B. SCADA - Supervisory Control and Data Acquisition system.
- C. OIS - Operator Interface Station.
- D. HIM - Human Interface Module - Used for local control of Variable frequency drives.
- E. REMOTE (AUTO) - Control is directed automatically from the PLC and Monitored by the SCADA system.
- F. REMOTE (MANUAL) - Allows the operator to manually override remote (auto) controls and operate equipment manually from the SCADA or OIS stations^{A1}
- G. LOCAL (MANUAL) - Local manual control at the MCC or Local control station from physical switches.

1.2 SYSTEM DESCRIPTION

- A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents.
 - 1. Descriptions are provided as follows:
 - a. Control system overview and general description.
 - b. Major equipment to be controlled.
 - c. Major field mounted instruments (does not include local gauges).
 - d. Manual control functions.
 - e. Automatic control functions/interlocks.
 - f. Major indications provided at local control panels and motor starters/VFD's.
 - g. Remote indications and alarms.
- B. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but are rather intended to supplement and complement the Drawings and other Specification Sections.
 - 1. The control loop descriptions shall not be considered equal to a bill of materials.
 - 2. The control loop descriptions for existing equipment shall not be altered unless otherwise noted in Part 3 - Execution.

- C. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.
- D. Ensure coordination of instrumentation manufacturer with other work to ensure that necessary wiring, conduits, contacts, interposing relays, loop-isolators, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 AREA 3 – AERATION BASINS & CLARIFIERS

A. MLR Pumps (Control Strategy 03-01)

- 1. P&ID Sheets: Y-001 & Y-002.
- 2. Description:
 - a. Recycle mixed liquor from Zone 3 to Zone 1 .
- 3. Equipment Schedule:

Description	Location	Equipment Tag No.
MLR Pump 05	Aeration Basin 03	P-311
MLR Pump 06	Aeration Basin 03	P-312
MLR Pump 07	Aeration Basin 04	P-313
MLR Pump 08	Aeration Basin 04	P-314

- 4. Equipment Protection:
 - a. VFD fault turns off pump.
 - b. TSH-311, TSH-312, TSH-313, & TSH-314 high motor temperature shutdown for MLR pumps.
 - c. XSH-311, XSH-312, XSH-313, & XSH-314 integrated moisture sensor for MLR pumps.
- 5. Local Control:
 - a. Local control switch HAND/OFF/AUTO (HOA) selector switch is installed at each pump VFD enclosure. When in the HAND position, the pump will operate. The pump speed will be based on operator input at the VFD keypad.
- 6. Plant PLC Control:
 - a. With the local HOA selector switch in the AUTO position the pump is controlled by Plant Control System. The operator can select between HMI MANUAL or HMI AUTOMATIC.
 - 1) HMI MANUAL:
 - a) Each pump may be started and stopped from the HMI and the operating speed may be manually adjusted from the HMI.
 - 2) HMI AUTOMATIC:
 - a) The MLR pumps are to run when their designated aeration basin is online.
 - b) The pumps will be automatically controlled using duplex pump control logic with an automatic alternator.
 - (1) The lead and lag pumps will start and run based on the operator selected MLR percentage of influent flow as calculated and totalized by existing LE/LIT-101 and LE/LIT-102.
 - (a) Initial setpoint for MLR flow rate shall be equal to 400 percent of influent flow divided by the number of basins online, up to a maximum flow at peak month conditions as calculated by the SCADA system.

- (b) Example: If influent totalized flow is 2.0 MGD and two basins are online (AB3 and AB4), MLR Pump 05 and MLR Pump 06 shall be set to provide 400 percent of 1.0 MGD.
- (2) Both pumps shall always run together when MLR flow rate is calling for greater than 1,200 GPM (both pumps running at 30 Hz).
 - (a) Integrator shall coordinate minimum system flow rate with Section 43 25 13 - Pumping Equipment - Submersible Non-Clog and MLR pump submittals to confirm the flow rate at 30 Hz.
- (3) Lag pump stops when MLR flow rate is calling for less than 1,200 GPM and lead pump will increase speed to hit flow setpoint.
- (4) If the lead pump fails to operate or is offline, the lag pump will operate and send MLR to Zone 1 at the operator-set percentage flow, up to the pump maximum flow rate.
- (5) There are no MLR flow meters. Pump and system design curves shall be integrated into control system to correlate flow rates to frequency provide to the pumps from their VFDs.
- (6) System shall include flow override to provide maximum MLR flow rate to be limited to two pumps running at 60 Hz if both pumps cannot meet operator-set MLR flow rate.
- (7) System shall include flow override to provide minimum MLR flow rate to be limited to one pump running at 30 Hz if the operator-set MLR flow rate is below the pump minimum flow.

7. SCADA HMI Configuration

- a. Status Display:
 - 1) Pump remote (4)
 - 2) Pump running (4)
 - 3) Pump VFD speed feedback (4)
- b. Operator Entries:
 - 1) Target flow rate (percentage of influent flow - adj.)
 - 2) Minimum flow alarm setpoint (adj.)
 - 3) Manual/Auto Mode selection (4)
 - 4) Manual Start/Stop control (4)
 - 5) Manual speed control (4)
 - 6) Pump alternating time entry
- c. Alarms:
 - 1) Pump VFD fault (4)
 - 2) Pump high temperature (4)
 - 3) Pump moisture alarm (4)

B. Aeration Blowers (Control Strategy 03-02)

- 1. P&ID Sheet: Y-003.
- 2. Description:
 - a. Provide process air into aerobic zones of aeration basins to maintain a minimum dissolved oxygen level in the aeration basins.
- 3. Equipment Schedule:

Description	Location	Equipment Tag No.
Aeration Blower 01	Blower Building	B-301
Aeration Blower 02	Blower Building	B-302
Aeration Blower 03	Blower Building	B-303
AB3 Z1 DO Analyzer	Aeration Basin 03 Zone 1	AE/AIT-307
AB3 Z2 DO Analyzer	Aeration Basin 03 Zone 2	AE/AIT-308
AB3 Z3 DO Analyzer	Aeration Basin 03 Zone 3	AE/AIT-309
AB4 Z1 DO Analyzer	Aeration Basin 04 Zone 1	AE/AIT-310

Description	Location	Equipment Tag No.
AB4 Z2 DO Analyzer	Aeration Basin 04 Zone 2	AE/AIT-311
AB4 Z3 DO Analyzer	Aeration Basin 04 Zone 3	AE/AIT-312
AB3 ORP Analyzer	Aeration Basin 03 Zone 1	AE/AIT-315
AB4 ORP Analyzer	Aeration Basin 04 Zone 1	AE/AIT-316
AB3 NO3-N Analyzer	Aeration Basin 03 Zone 1	AE/AIT-319
AB4 NO3-N Analyzer	Aeration Basin 04 Zone 1	AE/AIT-320
AB3 Z1 Aeration Control Valve	Aeration Basin 03 Zone 1	BFV-307-E
AB3 Z2 Aeration Control Valve	Aeration Basin 03 Zone 2	BFV-308-E
AB3 Z3 Aeration Control Valve	Aeration Basin 03 Zone 3	BFV-309-E
AB4 Z1 Aeration Control Valve	Aeration Basin 04 Zone 1	BFV-310-E
AB4 Z2 Aeration Control Valve	Aeration Basin 04 Zone 2	BFV-311-E
AB4 Z3 Aeration Control Valve	Aeration Basin 04 Zone 3	BFV-312-E
Aeration Blower 01 Flow Control Valve	Blower Building	BFV-313-E
Aeration Basin 04 Isolation Valve (Existing)	Blower Building	BFV-314-E

4. Equipment Protection:
 - a. VFD fault turns off pump.
 - b. TSH-316, & TSH-317 high motor temperature shutdown for B-302 and B-303.
 - c. A fault status issued from AERtronics LCP will result in VFD shutdown.
5. Local Control:
 - a. Local control switch HAND/OFF/AUTO (HOA) selector switch is installed at each pump VFD enclosure. When in the HAND position, the pump will operate. The pump speed will be based on operator input at the VFD keypad.
6. Plant PLC Control:
 - a. With the local HOA selector switch in the AUTO position the pump is controlled by Plant Control System. The operator can select between HMI MANUAL or HMI AUTOMATIC.
 - 1) HMI MANUAL:
 - a) Each pump may be started and stopped from the HMI and the operating speed may be manually adjusted from the HMI.
 - 2) HMI AUTOMATIC:
 - a) Aeration Control Valves Automatic Control:
 - (1) Existing BFV-314-E:
 - (a) Existing valve modulates to control an operator-set DO level in AB4.
 - (b) Valve control shall be adjusted to an operator-adjust percentage open. Initial setpoint shall be 100 percent open.
 - (2) Zone 1 control valves (BFV-307-E and BFV-310-E) are normally closed with operator-adjustable percentage open setpoints.
 - (3) Zone 2 control valves (BFV-308-E and BFV-311-E) are normally open set at a constant percentage open. Percentage open shall be manually determined during flow balance testing during startup. SCADA system shall have a memory of last-set percentage open.
 - (4) Zone 3 control valves (BFV-309-E and BFV-312-E) are modulating valves and automatically adjust to maintain an operator-set DO concentration in Zone 3 of the respective aeration basin (measured by AE/AIT-306 and AE/AIT-308).
 - (a) Initial setpoint for DO concentration shall be set to 1.5 mg/L.
 - b) Blower Automatic Control:
 - c) The blowers will be automatically controlled using a modified duplex blower control logic with an automatic alternator.

- (1) New blowers B-302 and B-303 shall be the primary lead and lag blower units.
- (2) Existing blower B-301 shall be the ultimate backup blower.
 - (a) B-301 shall run if both B-302 and B-303 fault.
 - (b) B-301 shall run if either B-302 or B-303 fault while in lag position if running blower cannot maintain set DO concentrations.
 - (c) BFV-313-E will modulate to maintain set DO concentrations.
- (3) The lead blower will start and run based on the operator selected DO concentration in active aeration basins.
 - (a) Initial setpoint for DO concentrations – AB1: 2.0 mg/L, measured by existing AE/AIT-301.
 - (b) Initial setpoint for DO concentrations – AB2: 2.0 mg/L, measured by existing AE/AIT-302.
 - (c) Initial setpoint for DO concentrations – AB3: 2.0 mg/L, measured by AE/AIT-308.
 - (d) Initial setpoint for DO concentrations – AB4: 2.0 mg/L, measured by AE/AIT-311.
- (4) The lead blower speed adjusts to maintain the DO concentrations.
- (5) Lag blower starts when lead blower cannot maintain set DO concentrations. Lead and lag blowers shall adjust to maintain an equal speed between both active blowers. The blowers shall adjust simultaneously to maintain DO concentrations.
- (6) If blower is running and minimum flow is detected an alarm shall be triggered.

7. SCADA HMI Configuration

- a. Status Display:
 - 1) Blower remote (3)
 - 2) Blower running (3)
 - 3) B-302 and B-303
 - a) Blower VFD speed feedback (2)
 - 4) B-301
 - a) Blower motor starter fault (1)
- b. Operator Entries:
 - 1) Target DO concentrations (AB1, AB2, AB3 Zones 2 and 3, AB4 Zones 2 and 3 - adj.)
 - 2) Minimum flow alarm setpoint (adj.)
 - 3) Manual/Auto Mode selection (2)
 - 4) Manual Start/Stop control (3)
 - 5) Manual speed control (2)
 - 6) Blower alternating time entry
- c. Alarms:
 - 1) Blower VFD fault (2)
 - 2) Blower high temperature (2)
 - 3) Minimum flow alarm; Do not adjust from existing flow rate.

C. Anoxic Mixers (Control Strategy 03-03)

1. P&ID Sheets: Y-001 & Y-002.
2. Description:
 - a. Provide mixing energy into the anoxic zone of each aeration basin to keep mixed liquor in suspension.
3. Equipment Schedule:

Description	Location	Equipment Tag No.
Anoxic Mixer 03	Aeration Basin 03 Zone 1	MXR-303
Anoxic Mixer 04	Aeration Basin 04 Zone 1	MXR-304

4. Equipment Protection:
 - a. None.
5. Local Control:
 - a. Local control switch HAND/OFF/AUTO (HOA) selector switch is installed at the mixer motor starter MCC bucket. When in the HAND positions, the mixer will operate.
6. Plant PLC Control:
 - a. Manual ON/OFF toggles shall be included
 - b. With the local HOA selector switch in the AUTO position the mixer is controlled by Plant Control System.
 - 1) The mixers are to run when their designated aeration basin is online.
7. SCADA HMI Configuration
 - a. Status Display:
 - 1) Mixer remote (2)
 - 2) Mixer running (2)
 - 3) Mixer motor starter fault (2)
 - b. Operator Entries:
 - 1) Manual/Auto Mode selection (2)
 - 2) Manual Start/Stop control (2)
 - c. Alarms:
 - 1) Mixer motor starter fault (2)

END OF SECTION

SECTION 40 91 10
PRIMARY METERS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flow components.
 - 2. Pressure components.
 - 3. Analytical components.
 - 4. Temperature components.
 - 5. Level Components.
 - 6. Pipe, tubing and fittings.
 - 7. Instrument valves.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 90 00 - Instrumentation for Process Control: Basic Requirements.
 - 4. Section 40 90 05 - Control Loop Descriptions.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Gas Association (AGA):
 - a. Gas Measurement Committee Report #3.
 - 2. American Iron and Steel Institute (AISI).
 - 3. American National Standards Institute (ANSI).
 - 4. American Society of Mechanical Engineers (ASME):
 - a. B16.5, Pipe Flanges and Flanged Fittings.
 - b. B31.1, Power Piping.
 - c. PTC 19.3, Instruments and Apparatus, Part 3 Temperature Measurement.
 - d. PTC 19.5, Application of Fluid Meters, Part 2.
 - e. Section II, Part A SA-182, Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - f. Section II, Part A SA-479, Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
 - 5. ASTM International (ASTM):
 - a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - c. A182, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - d. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - e. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - f. A479, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
 - g. B16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
 - h. B75, Standard Specification for Seamless Copper Tube.
 - i. B124, Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.

- j. B283, Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).
- k. B453, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes.
- 6. Federal Communications Commission (FCC)
 - a. 47 CFR 15, Radio Frequency Devices.
- 7. The International Electrotechnical Commission (IEC)
 - a. IEC 751 Platinum Resistance Thermometer Sensor
- 8. The International Society of Automation (ISA):
 - a. MC96.1, Temperature Measurement Thermocouples.
- 9. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 10. US Department of Interior Bureau of Reclamation (USDIBR):
 - a. Water Measurement Manual.

1.3 SYSTEM DESCRIPTION

- A. The instruments specified in this Specification Section are the primary element components for the control loops shown on the "PID" series Drawings and specified in Specification Section 40 90 05.
 - 1. These instruments are integrated with other control system components specified under Specification Section 40 90 00 series to produce the functional control defined in the Contract Documents.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 90 00.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 TEMPERATURE COMPONENTS

- A. Thermometer:
 - 1. Acceptable manufacturers:
 - a. Ashcroft.
 - b. Ametek.
 - c. Or approved equal.
 - 2. Materials:
 - a. Case: 316 stainless steel.
 - b. Ring: 316 stainless steel.
 - c. Stem: 316 stainless steel.
 - d. Thermowell: ASTM A182, F316 stainless steel.
 - e. Bulb: AISI 316 stainless steel.

3. Design and fabrication:
 - a. Type:
 - 1) Bimetallic for applications not exceeding 800 DEGF.
 - 2) Inert gas filled for applications exceeding 800 DEGF.
 - b. Every angle case connection.
 - c. Hermetically sealed case with external adjustment.
 - d. Dial:
 - 1) Minimum 4-1/2 IN.
 - 2) White face.
 - 3) Black numbers and pointer.
 - e. Thermometer well:
 - 1) Extension neck for insulated lines.
 - f. Accuracy +/-1 PCT of full span.
 - g. Shatterproof glass.
4. Schedule:

A. RTD's:

1. Acceptable manufacturers:
 - a. Endress & Hauser
 - b. Rosemount.
 - c. Moore Industries
 - d. Or approved equal
2. Materials:
 - a. Sensor: Platinum.
 - b. Sheath:
 - 1) 900 DEGF maximum: Type 316 stainless steel.
 - 2) 1200 DEGF maximum: Inconel.
 - c. Insulation: Ceramic or metallic oxide.
3. Design and fabrication:
 - a. IEC 60751 Class A type
 - b. 100 ohms at 0 DEGC.
 - c. Spring loaded.
 - d. Lead wire compensation: Three- or four-wire.
 - e. Accuracy: +0.15 DEGF or +0.5 PCT of measured temperature, whichever is greater.
 - f. Sheath diameter: 1/4 IN.

B. Thermocouples:

1. Acceptable manufacturers:
 - a. Endress & Hauser
 - b. Rosemount.
 - c. Moore Industries
 - d. Or approved equal
2. Materials:
 - a. Sheath:
 - 1) 1600 DEGF maximum: Type 304 or 316 stainless steel.
 - 2) 2100 DEGF maximum: Inconel.
 - b. Insulation: Ceramic or metallic oxide.
3. Design and fabrication:
 - a. Type: J.
 - b. Spring loaded.
 - c. Ungrounded.
 - d. Sheath diameter: 1/4 IN.
 - e. Lead wires: 20 AWG minimum.
 - f. Color-coded wire insulation per ISA MC96.1.

- g. Tolerance per ISA MC96.1.
- C. Thermowells:
1. Acceptable manufacturers:
 - a. Endress & Hauser
 - b. Rosemount.
 - c. Moore Industries
 - d. Or approved equal
 2. Materials:
 - a. Well: ASTM A182, F316 stainless steel.
 - b. Head: Cast iron.
 3. Design and fabrication:
 - a. Constructed in accordance with ASME PTC 19.3, Part 3, Chapter 1, Paragraphs 8-19.
 - b. Lagging extension sufficient to provide wrench clearance above lagging.
 - c. Seal welded on applications where process pressure exceeds 450 PSI.
 - d. Test thermowells shall be supplied with watertight cap and chain.
- D. Temperature Transmitters:
1. Acceptable manufacturers:
 - a. Endress & Hauser TMT162.
 - b. Rosemount, Model 3144.
 - c. Foxboro, I/A series.
 - d. Moore Industries TDZ.
 - e. Or approved equal.
 2. Materials:
 - a. Housing: Aluminum.
 3. Design and fabrication:
 - a. Smart transmitter utilizing microprocessor based electronics.
 - b. Input: RTD, thermocouple or millivolt, as specified in schedule.
 - c. Transmitter inaccuracy shall be in consistent with with the type & class of element it is connected to :
 - 1) 100 ohm platinum RTD input: +/-0.63 DEGF at -148 DEGF and +/-2.07 DEGF at 500 DEGF.
 - 2) Type E thermocouple input: 0 to 900 DEGC +/-1.7 DEGC or +/- +0.5 PCT of span, whichever is greater.
 - 3) Type J thermocouple input: 0 to 750 DEGC +/-2.2 DEGC or +/- +0.75 PCT of span, whichever is greater.
 - 4) Type K thermocouple input: 0 to 1250 DEGC +/-2.2 DEGC or +/- +0.75 PCT of span, whichever is greater.
 - 5) Type R thermocouple input: 0 to 1450 DEGC +/-1.5 DEGC or +/- +0.25 PCT of span, whichever is greater.
 - 6) Type S thermocouple input: 0 to 1450 DEGC +/-1.5 DEGC or +/- +0.25 PCT of span, whichever is greater.
 - 7) Type T thermocouple input: -200 to 0 DEGC +/-1 DEGC or +/- +1.5 PCT of span, whichever is greater
 - 8) Millivolt input: +/-0.015 mV +0.02 PCT of span or +/-8 microvolts +0.025 PCT of span, whichever is greater.
 - d. Stability:
 - 1) Any of the following drift limits are acceptable:
 - a) Greater of: 0.1 PCT of reading or 0.1 DEGC per 12 months.
 - b) 0.05 PCT of input reading plus 0.043 PCT of span per 12 months.
 - c) 0.05 PCT of maximum span per 12 months.
 - e. Ambient temperature effects (including digital, D/A conversion, and cold junction effects):
 - 1) Any of the following effects per 50 DEGF change are acceptable:
 - a) One-half reference inaccuracy plus 0.18 DEGF.

- b) Effects in accordance with the following inputs:
 - (1) 100 platinum RTD input: +/-0.08 DEGC +0.025 PCT of (reading +200) +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (2) Type E thermocouple input: +/-0.10 DEGC +0.012 PCT of (reading +200) +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (3) Type J thermocouple input:
 - (a) Readings above 0 DEGC: +/-0.11 DEGC +0.008 PCT of (reading +200) +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (b) Readings below 0 DEGC: +/-0.11 DEGC +0.056 PCT of absolute value of reading +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (4) Type K thermocouple input:
 - (a) Readings above 0 DEGC: +/-0.13 DEGC +0.015 PCT of (reading +200) +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (b) Readings below 0 DEGC: +/-0.13 DEGC +0.056 PCT of absolute value of reading +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (5) Type N thermocouple input: +/-0.15 DEGC +0.010 PCT of reading +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (6) Type R thermocouple input:
 - (a) Readings above 200 DEGC: +/-0.42 DEGC +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (b) Readings below 200 DEGC: +/-0.60 DEGC - 0.090 PCT of reading +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (7) Type S thermocouple input:
 - (a) Readings above 200 DEGC: +/-0.42 DEGC +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (b) Readings below 200 DEGC: +/-0.60 DEGC - 0.090 PCT of reading +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (8) Type T thermocouple input:
 - (a) Readings above 0 DEGC: +/-0.13 DEGC +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (b) Readings below 0 DEGC: +/-0.13 DEGC 0.100 PCT of absolute value of reading +0.025 PCT of span +0.02 PCT of (reading - lower range value).
 - (9) Millivolt input: 0.003 mV +0.012 PCT of absolute value of reading +.025 PCT of span +0.02 PCT of (reading - lower range value).
 - f. Ambient temperature limits:
 - 1) -40 to 185 DEGF.
 - 2) Integral LCD meter: -4 to 158 DEGF.
 - g. Output: 4-20 mA DC signal linearly proportional to temperature.
 - h. Power supply: 24 VDC.
 - i. Adjustable span.
 - j. Adjustable zero.
4. Schedule:

- E. Temperature Switches:
 - 1. Acceptable manufacturers:

- a. Ashcroft.
- b. United Electric.
- c. Or approved equal
- 2. Design and fabrication:
 - a. Contact rating:
 - 1) 1 amp inductive at 125 VDC.
 - 2) 5 amp inductive at 120 VAC.
 - b. Switch accuracy: 1 PCT or better.
- 3. Schedule:

2.3 FLOW COMPONENTS

- A. Magnetic Flow Meters:
 - 1. Acceptable manufacturers:
 - a. Endress & Hauser
 - b. Siemens
 - c. Emerson Process - Rosemount.
 - d. Krohne.
 - e. Or approved equal
 - 2. Materials used shall be fully compatible with process and service requirements:
 - a. Meter tube of 304 stainless steel.
 - b. The flow tube liner shall be hard rubber elastomer, Neoprene or PTFE to meet temperature, pressure rating. The liner shall be chemically and mechanically compatible with the process fluids being measured.
 - 1) The measuring electrodes/sensors shall be Titanium or Alloy C electrodes. The electrodes shall be chemically and mechanically compatible with the process fluids being measured.
 - c. Grounding rings: 316 stainless steel, or as noted.
 - 3. Design and fabrication:
 - a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
 - b. Service: As noted. Percent solids content of thickened sludge type process streams is identified in the Schedule below.
 - c. Meters identified with the “High Noise” are to be designed to measure process streams with high solids contents and high noise conditions.
 - d. Provide cable between magnetic flow meter and transmitter with length as required for the installation.
 - e. Pulsed DC magnetic field excitation.
 - f. Inaccuracy:
 - 1) Above 10 percent of range: ± 1.0 percent of rate.
 - 2) Below 10 percent of range: ± 0.1 percent of range setting.
 - 3) Add +0.1 percent of range to above inaccuracies for analog outputs.
 - g. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
 - h. Flow Tube:
 - 1) Provide flanged end connections per ASME B16.5 rated for piping system operating and test conditions.
 - 2) Operating pressure: 0 to 150 psi.
 - 3) Operating temperature: 20 to 150 DegF.
 - 4) Inlet and outlet grounding rings of same material as electrode.
 - 5) Flow Tube sensor coil resistance:
 - a) Normal service: 350 Ohms maximum.
 - b) High noise service: 12 Ohms maximum.
 - 6) Process liquid conductivity limits:
 - a) Normal service: 5 microsiemens/cm, minimum.

- b) High noise service: 50 microsiemens/cm, minimum.
- i. Transmitter:
 - 1) Each flow meter shall be furnished with a separately-mounted transmitter, unless shown otherwise.
 - 2) Transmitter electronics shall use microprocessor based architecture and be configured using field adjustable parameters via front panel keypad and HART calibrator.
 - 3) Housing requirements: watertight, NEMA 4X rated, wall-mount enclosure.
 - 4) Power supply: 117 V +10 percent, 60 Hz.
 - 5) Indication of flow rate and totalized flow in engineering units.
 - 6) Adjustable low flow cutoff.
 - 7) Automatic zero.
 - 8) Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
 - 9) High signal type operation where required to measure process streams with high solids contents and high noise conditions.
 - 10) 4-20 mA DC isolated output into maximum 800 ohms.
 - 11) Signal damping: adjustable between 0.2 and 256 seconds.
 - 12) Transmitter may be configured using hand-held HART Communicator.
- 4. Schedule:

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NOTES:

- 1. Transmitter integrally mounted with flow tube.
- 2. Flow tube shall be rated for accidental submergence. IP 68 submergence protection.
- 3. High noise service.
- 4. Flow tube rated for Class I, Division 2 Hazardous Locations.

B. Thermal Dispersion Type Flow Switches:

- 1. Acceptable manufacturer:
 - a. Magnetrol ThermoTel TD2 w/ Spherical Tip.
- 2. Materials:
 - a. All wetted surfaces: 316 stainless steel.
 - b. Enclosure: Cast iron or aluminum.
- 3. Design and fabrication:
 - a. Solid state electronics.
 - b. Repeatability: +/-1 percent of full signal.
 - c. Response time: Adjustable down to 1 second.
 - d. Utilize two (2) platinum RTD's in thermowells in flow stream for differential temperature measurement.
 - e. Two switch points.
 - f. Two (2) SPDT switch contacts rated:
 - 1) 1 amp inductive at 24 Vdc.
 - 2) 5 amp inductive at 120 Vac.
 - g. Process connections: 3/4 IN MNPT.
 - h. Power supply: 115 Vac, +/-10 percent at 60 Hz.
 - i. Process temperature: 140 DEGF .
 - j. Process pressure: WAS = 15psi, Duct mounted 0-4 in H2O.
- 4. Schedule:

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2.4 LEVEL ELEMENTS

A. Ultrasonic Level Sensor and Transmitter:

1. Acceptable manufacturers:
 - a. Siemens The Probe.
 - b. Endress + Hauser.
 - c. Rosemount.
 - d. Or approved equal
2. Materials:
 - a. Sensor wetted parts: PVC, polypropylene, KYNAR or polyvinylidene fluoride (PVDF).
3. Design and fabrication:
 - a. Sensor:
 - 1) Emits ultrasonic sound.
 - 2) Detects return echo reflected from surface and converts it to electrical energy proportional to level.
 - b. Temperature compensated.
 - c. Capable of being configured to ignore false targets.
 - d. Operating temperature: -4 to 140 DegF.
 - e. Humidity: 95 percent non-condensing.
 - f. Transmitter:
 - 1) Capable of producing output signal proportional to level of 4-20 mA.
 - 2) Power supply: 120 Vac (+/-10 percent), 60 Hz.
 - 3) Inaccuracy: 0.25 percent of range or 0.24 IN, whichever is greater.
 - 4) Resolution: 0.1 percent of span or 0.08 IN, whichever is greater.
 - 5) Display: Four-digit LED or LCD scalable to engineering units with selectable decimal point.
 - 6) Temperature: -5 to 122 DegF.
 - 7) Humidity: 95 percent noncondensing.
 - 8) Memory: EEPROM (non-volatile).
 - 9) Keypad programmer.
4. Schedule:

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B. Mechanical Tilt Switches

1. Acceptable manufacturers:
 - a. Gems Series M
 - b. Or approved equal
2. Materials
 - a. Impact and corrosion resistant ABS
 - b. Oil resistant cable
3. Design and Fabrication:
 - a. Non-Mercury switch
 - b. Provides SPDT, Form C switch closure at approximately 2-8” of tilting angle
 - c. Contact Rating: 13A @ 120/240VAC
 - d. Operating Temperature: 32 DEGF – 140 DEGF
 - e. Narrow angle
4. Schedule:

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2.5 PRESSURE COMPONENTS

- A. Pressure Transmitters:
 - 1. Acceptable manufacturers:
 - a. Endress & Hauser Cerabar
 - b. Rosemount, Model 3051S.
 - c. Foxboro, I/A series.
 - d. Or approved equal
 - 2. Materials:
 - a. Isolating diaphragm: 316 stainless steel.
 - b. Process flanges and adapters: 316 stainless steel.
 - c. Housing: Aluminum.
 - d. Vent/drain valve: 316 stainless steel.
 - e. Fill fluid:
 - 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.
 - a) Agents include but are not limited to: Cl₂, KMN04, FeCl, NaOH, and NaOCl.
 - 2) Utilize manufacturer's standard fill for other applications.
 - a) Ensure fill is suitable for application temperatures.
 - 3. Design and fabrication:
 - a. Smart transmitters utilizing microprocessor based electronics with LCD or LED screen.
 - b. Output: 4-20 mA DC proportional to pressure.
 - c. Nonvolatile EEPROM memory.
 - d. Power supply: 24 Vdc.
 - e. Adjustable zero and span.
 - f. Temperature limits: -20 to 180 DegF.
 - 1) -4 to 175 DegF for LCD indicators.
 - g. Overpressure limits: Withstand 150 percent of stated maximum service pressure without damage.
 - h. Humidity limits: 0 to 100 percent relative humidity.
 - i. Damping: Adjustable between 0 and 32 seconds.
 - j. Inaccuracy (includes effects of linearity, repeatability and hysteresis): +/-0.10 percent of calibrated span for 15:1 rangeability.
 - k. Stability: +/-0.2 percent of upper range limit for 12 months.
 - l. Temperature effect:
 - 1) Total effect including span and zero errors: +/-0.2 percent of upper range limit per 100 DegF for minimum 15:1 rangeability.
 - m. Minimum 1/2 IN pressure connection.
 - n. Equip with test jacks or accessible terminals for testing output.
 - o. Equip with isolation valve and test connections with isolation valves and/or plugs.
 - p. Pressure rating: To meet requirements of the application.
 - 4. Schedule:

Tag Number	Application	Line Size
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- B. Pressure Switches
 - 1. Acceptable manufacturers
 - a. Mercoid
 - b. Automatic Switch Company
 - c. United Electric
 - d. Or approved equal
 - 2. Materials:
 - a. Wetted switch elements: 316 stainless steel.
 - b. Diaphragm seal housing: 316 stainless steel.
 - 3. Accessories:

- a. Provide ball valve to isolate pressure switch from source.
 - b. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on pressure switch as shown on schedule.
 - c. On applications where a pressure switch and a pressure gage are used at the same location, it is permissible to utilize one (1) pulsation dampener and diaphragm seal to isolate both elements from the process fluid.
4. Design and fabrication:
- a. Utilize hermetically sealed mercury contact switches.
 - b. Two (2) SPDT contacts rated:
 - 1) 1 amp inductive at 24 Vdc.
 - 2) 5 amp inductive at 120 Vac.
 - c. Switch set points:
 - 1) Above 1,000 psi:
 - a) Between 30 and 35 percent of switch rated working range.
 - b) Operating pressure range not to exceed 35 percent of switch rated working pressure.
 - 2) Below 1,000 psi:
 - a) Set points between 30 and 70 percent of switch rated working range.
 - b) Operating pressure not to exceed 75 percent of switch rated working range.
 - d. Accuracy: Better than 1 percent of full scale.
 - e. Process connection: Minimum of 1/4 IN.
5. Schedule:

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C. Pressure Gage:

- 1. Acceptable manufacturers:
 - a. Ashcroft.
 - b. Ametek.
 - c. Or approved equal
- 2. Materials:
 - a. Bourdon tube, socket, connecting tube: 316 stainless steel.
 - b. Case: Phenolic.
 - c. Pressure snubber:
 - 1) Filter disc: 316 stainless steel.
 - 2) Housing: 316 stainless steel.
- 3. Accessories:
 - a. Provide valve at point of connection to equipment and at panel if panel mounted.
 - b. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on gage applications as shown on schedule.
 - c. Provide 1/2 IN stainless steel antisiphon pigtail inlet connection for hot water and steam applications.
- 4. Design and fabrication:
 - a. All components suitable for service at:
 - 1) 250 DegF.
 - 2) The maximum process temperature to which the gage is to be exposed.
 - b. Provide viewer protection from element rupture.
 - c. Calibrate gages at jobsite for pressure and temperature in accordance with manufacturer's instructions.
 - d. Unless otherwise required by codes, provide stem mounted or flush mounted, as required, with dial diameter as follows:

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- e. Equip with white faces, black numerals and black pointers.
 - f. Gage tapping position to be clear of equipment functions and movements, and protected from maintenance and operation of equipment.
 - 1) Gage to be readable from an accessible standing position.
 - g. Gage accuracy: 1 percent of full range.
 - h. Select gage range so that:
 - 1) The normal operating value is in the middle third of the dial.
 - 2) Maximum operating pressure does not exceed 75 percent of the full scale range.
5. Schedule:

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6. Diaphragm Seal:
- a. Acceptable manufacturers:
 - 1) Ashcroft.
 - 2) Ametek.
 - b. Materials:
 - 1) Lower housing: 316 stainless steel.
 - 2) Diaphragm material: 316 stainless steel.
 - c. Design and fabrication:
 - 1) Isolates instrument from process fluids which are corrosive or contain solids.
 - 2) Upper housing with bleed screw.
 - 3) Lower housing with flushing connection.
 - 4) Fill fluid:
 - a) Utilize halocarbon fill for process applications involving strong oxidizing agents.
 - (1) Agents include but are not limited to: Cl₂, KMNO₄, FeCl, NaOH, and NaOCl.
 - b) Utilize manufacturer's standard fill for other applications.
 - (1) Ensure fill is suitable for application temperatures.
 - 5) Process connections:
 - a) Instrument: 1/2 IN NPT.
 - b) Process: 0.5 IN female NPT.
 - c) PVC pipe applications: Use a socket weld connection.
 - d. Installed where specified or shown on Drawings.

D. In-Line Isolation Sleeve (Annular Seal):

- 1. Acceptable manufacturers:
 - a. Red Valve.
 - b. Or approved equal.
- 2. Materials:
 - a. Body: carbon steel.
 - b. Flanges: carbon steel.
 - c. Flexible liner: Buna-N.
- 3. Design and fabrication:
 - a. Provide full 360 degree annular pressure sensor with flexible in-line sleeve.
 - b. Sensor shall not restrict the process flow (non-intrusive).
 - c. ANSI Class 150.
 - d. Instrument connection: 0.5 IN female NPT.
 - e. Fill fluid:
 - 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.

- a) Agents include but are not limited to: Cl₂, KMNO₄, FeCl, NaOH, and NaOCl.
- 2) Utilize manufacturer's standard fill for other applications.
 - a) Ensure fill is suitable for application temperatures.
- 3) Pressure rating: To meet requirements of the application.
- f. Installed where specified or shown on Drawings.

2.6 ANALYTICAL ELEMENTS

A. Combustible and Toxic Gas Detectors:

1. Acceptable manufacturers:
 - a. Honeywell.
 - b. MSA Instruments.
 - c. Oldham
 - d. Or approved equal
2. Control unit:
 - a. Front mounted indication.
 - 1) Minimum three-digit display of gas concentration associated with each sensor.
 - 2) Alarm status indicators for each gas sensing channel:
 - a) Trouble.
 - b) High gas level detected.
 - c) High high gas level detected.
 - b. Alarm relay outputs:
 - 1) Separate contacts for each alarm or trouble condition associated with each gas sensing channel.
 - 2) Separate "system trouble" contact to indicate trouble in the event any of the following conditions are true:
 - a) System power loss.
 - b) Signal loss from any sensor.
 - c) Signal out of appropriate range.
 - d) Control module malfunction or removal.
 - 3) Each output contact shall be Form C, SPDT, rated for 3 amps resistive at 120 Vac.
 - c. Output signals: 4-20 mA signal representing gas concentration for each gas sensor.
 - d. Temperature range: 32 to 158 DegF.
 - e. Relative humidity range: 0-95 percent non-condensing.
3. Sensor and transmitter design and fabrication:
 - a. Sensor mounting type shall be as indicated on schedule: Either diffusion mounted, duct mounted, or sample draw mounted.
 - b. For sensors required by schedule to be sample draw type:
 - 1) Provide a compressed air aspirator or motorized pump to draw a sample past the sensor.
 - 2) Utilize a flow switch to provide annunciation of low sample flow rate to the sensor.
 - c. Duct mounted gas sensor shall be able to monitor gas flow rates up to 85 fps.
 - d. Combustible gas sensor shall be catalytic bead type with demonstrated resistance to poisoning by silicones and hydrogen sulfide gases.
 - e. Toxic gas sensor shall be the electrochemical type and shall not require the periodic addition of reagents.
 - f. Interconnect wiring from sensor to transmitter (if not integral) or control unit shall be 3 wire shielded cable.
 - g. Sensing element shall have minimum useful life of one (1) year.
 - h. Transmitter output: 4-20 mA signal proportional to measured gas level.
 - 1) Capable of driving 600 ohm load at 24 Vdc supply voltage.
 - i. Accuracy:
 - 1) Combustible gas detection:
 - a) +3 percent LEL to 50 percent full scale.
 - b) +5 percent LEL, 50 to 100 percent full scale.

- 2) Toxic gas detection:
 - a) +10 percent full scale or 2 PPM, whichever is greater.
- j. Environmental:
 - 1) Ambient operating temperature: -40 to 185 DegF.
 - 2) Relative humidity: 0-95 percent non-condensing.
- k. Housing: In accordance with the area classification shown on Drawings.
- l. Provide nonintrusive means of calibration.
- m. Local displays:
 - 1) 3-1/2 digit LCD or LED display of measured gas level.
 - 2) Fault LED.
- n. Stand alone sensors and transmitters (without central control unit):
 - 1) Provide relay contacts rated at 1/2 amps at 120 Vac for each of the following conditions:
 - a) High gas level (warning level).
 - b) High high gas level (alarm level).
 - c) Sensor fault condition.
- o. Relay contacts shall be normally energized (normally closed); contacts shall open in the event of a warning, alarm or trouble condition.
- p. Minimum detector response time when exposed to 100 percent LEL gas concentration:
 - 1) 10 seconds to 50 percent LEL.
 - 2) 30 seconds to 90 percent LEL.
- q. Store calibration data in nonvolatile memory or back up with battery.
- 4. Provide one (1) calibration kit for each type of gas monitored.
 - a. Calibration kits shall be furnished complete with all tubing, regulators, fittings, communication devices, and accessories required to calibrate sensors.
 - b. Calibration kit shall utilize nonintrusive means of calibrating sensors/transmitters.
- 5. Provide two (2) full cylinders of each type of calibration check gas.
 - a. Cylinder size: 17 liters.
- 6. Provide the same quantity of zero air cylinders as the total required number of calibration check gas cylinders (of all types).
- 7. Schedule:

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MOUNT TYPE: D - diffusion type, DM - duct mounted, SD - sample draw, F - Fixed Gas Wall Mount

2.7 PIPE, TUBING, AND FITTINGS

- A. Acceptable Manufacturers:
 - 1. Tube fittings:
 - a. Parker CPI.
 - b. Swagelok.
 - c. Or approved equal.
- B. Instrument Tubing and Fittings:
 - 1. Material:
 - a. Tubing: ASTM A269, Grade TP 316 stainless steel.
 - b. Straight fittings: 316 stainless steel per ASME SA-479 or ASTM A276.
 - c. Shaped bodies: ASME SA-182 F316 stainless steel.
 - 2. Design and fabrication:
 - a. Tubing:
 - 1) Seamless.
 - 2) Fully annealed.
 - 3) Maximum hardness: 80 Rb.
 - 4) Free from surface scratches and imperfections.
 - 5) Diameter: 1/2 IN OD unless specified otherwise.

- 6) Wall thickness:
 - a) Meet requirements of ASME B31.1, Paragraph 122.3.
 - b) Minimum 0.049 IN for 1/2 IN OD tubing.
 - b. Fittings:
 - 1) Flareless.
 - 2) Compression type.
- C. Instrument Piping:
- 1. For applications where the instrument is supported solely by the sensing line, (e.g., pressure gauge directly mounted to process line) utilize piping as specified below.
 - a. Diameter: 1/2 IN unless specified otherwise.
 - b. Schedule 80.
 - c. 316 stainless steel. fittings per ASTM A234}.
- D. Pneumatic Signal Tubing:
- 1. Material: Copper per ASTM B75.
 - 2. Design and fabrication:
 - a. Soft annealed.
 - b. Free from surface scratches and imperfections.
 - c. Wall thickness:
 - 1) 0.030 IN for 1/4 IN OD.
 - 2) 0.035 IN for 3/8 IN OD.
- E. Pneumatic Tube Fittings:
- 1. Material:
 - a. Straight fittings: Brass per ASTM B16 and ASTM B453.
 - b. Shaped bodies: Brass per ASTM B124 Alloy 377 or ASTM B283.
 - 2. Design and fabrication:
 - a. Flareless.
 - b. Compression type.

2.8 INSTRUMENT VALVES

- A. Process instrument multi-valve manifolds, isolation, vent and blow-down valves:
- 1. Acceptable manufacturers:
 - a. Whitey Co.
 - b. Anderson-Greenwood USA, Inc.
 - c. Or approved equal.
 - 2. Materials:
 - a. Packing:
 - 1) 450 DegF and above: Graphite.
 - 2) Below 450 DegF: Graphite or Teflon.
 - b. Body: 316 stainless steel per ASTM A479.
 - c. Stem: 316 stainless steel per ASTM A276.
 - d. Ball: 316 stainless steel per ASTM A276.
 - e. Support rings: 316 stainless steel per ASTM A276.
 - f. Seats:
 - 1) Metal:
 - a) 316 stainless steel per ASTM A276.
 - 2) Soft:
 - a) Teflon, Delrin.
 - b) Only utilized on applications where manufacturer's temperature and pressure ratings exceed process design conditions.
 - 3. Design and fabrication:
 - a. Either of the following:
 - 1) Ball valve with 1/4 turn activation.
 - 2) Free-swiveling ball stem.

- b. Provide body wall thickness sufficient for process design conditions per ASME B31.1.
 - c. Temperature: Manufacturer's temperature rating for all components shall exceed process design conditions.
- B. Isolation Valves in Copper Instrument Air Tubing:
- 1. Acceptable manufacturer:
 - a. Whitey Co.
 - 2. Materials:
 - a. Packing: Graphite or Teflon.
 - b. Body: Brass per ASTM B16.
 - c. Stem: 316 stainless steel per ASTM A276.
 - d. Ball: 316 stainless steel per ASTM A276.
 - e. Support rings: 316 stainless steel per ASTM A276.
 - f. Seats:
 - 1) Metal: 316 stainless steel per ASTM A276.
 - 2) Soft:
 - a) Teflon, Delrin.
 - b) Only utilized on applications where manufacturer's temperature and pressure ratings exceed process design conditions.
 - 3. Design and fabrication:
 - a. Ball valve with 1/4 turn activation.
 - b. Provide body wall thickness sufficient for process design conditions per ASME B31.1.

2.9 ACCESSORIES

- A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
- 1. Materials, unless otherwise specified, shall be as follows:
 - a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
 - b. Mounting brackets:
 - 1) Standard: 316 stainless steel.
 - 2) Highly corrosive areas: Aluminum.
 - c. Mounting plates, angles:
 - 1) Standard: Carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
 - d. Instrument pipe stands:
 - 1) Standard: Hot-dip galvanized 2 IN schedule 40, ASTM A106, Grade B carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
- B. Tubing Support Angles and Brackets:
- 1. Any of the following materials are acceptable:
 - a. Aluminum support with dielectric material between support and tubing.
 - b. Type 316 stainless steel.
 - c. Fiberglass.
- C. Tubing Tray or Channel:
- 1. Aluminum.
 - 2. Provide dielectric material between tray or channel and tubing.
- D. Provide handheld communicator compatible with all intelligent transmitters furnished.
- 1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
 - 2. If these features are provided with the intelligent transmitter, the hand held communicator is not required.
- E. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install instrument mounting pipe stands level and plumb.
- C. Instrument Valves:
 - 1. Orient stems for proper operation.
 - 2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
 - 3. Provide a minimum of 2 IN clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
 - 4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
 - a. When cool, reassemble the valves.
 - 5. Support each valve individually.
 - a. The tubing system does not qualify as support for the valve.
- D. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.
- E. Keep foreign matter out of the system.
- F. Remove all oil on piping and tubing with solvent before piping and tubing installation.
- G. Plug all open ends and connections to keep out contaminants.
- H. Tubing Installation:
 - 1. General:
 - a. Install such that tube shows no sign of crumpling, bends of too short a radius, or flattening, etc.
 - b. Make tube runs straight and parallel or perpendicular to the floor, equipment and piping runs.
 - c. For liquid and steam applications, slope continuously from the process to the instrument with a minimum slope of 0.50 IN per foot.
 - d. For gas and air applications, slope continuously from the instrument to the process with a minimum slope of 0.50 IN per foot.
 - e. If the sensing line cannot be continuously sloped, install high point vents and low point drains.
 - f. Keep instrument tubing clean during all phases of work.
 - g. Blow out with clean, dry, oil-free air immediately before final assembly.
 - h. Cut by sawing only and debur.
 - 2. Bending:
 - a. Make each bend with tube bender of the correct size for the tube.
 - b. Make all bends smooth and continuous.
 - c. Rebending is not permitted.
 - d. Make bends true to angle and radius.
 - e. Maintain a true circular cross section of tubing without buckling or undue stretch of tube wall.
 - f. Allowable tolerance for flattening out of tubing bends: Maximum of 8 percent of the OD for stainless steel tubing.
 - g. Minimum bending radius for stainless steel tubing:

1/4	9/16
3/8	15/16
1/2	1-1/2

- h. Minimum bending radius for type L, hard (drawn) copper:

3/8	1-3/4
1/2	2-1/2

- 3. Tubing support:
 - a. Intermittently support by clamping to support angle.
 - b. Install supports to be self-draining, supported by hangers, or cantilevered from walls or structural beams.
 - c. Support at 5 FT-0 IN maximum spans for horizontal or vertical runs.
 - d. Use tubing trays in areas where spans between supports are greater than 5 FT and for all signal tubing support.
 - e. Support each tubing tray at 10 FT maximum spans.
 - f. Align tubing in orderly rows and retain in the tray by bolted clips.
 - 1) The use of spring or speed clips is not acceptable.
 - g. Maintain order of the tubing throughout the length of the tray.
 - h. Locate angle, channel and tray installation to protect tubing from spills and mechanical damage.
 - i. Locate support members to clear all piping, conduit, equipment, hatchways, monorails, and personnel access ways and allow access for equipment operation and maintenance.
 - j. Support trays to prevent torsion, sway or sag.
 - k. Permanently attach supports to building steel or other permanent structural members.
 - l. Arrange supports and trays so that they do not become a trough or trap.
- 4. Routing and orientation:
 - a. Route to maintain a minimum headroom clearance of 8 FT.
 - b. Locate and orient valves and specialties so that they are accessible for operation and maintenance from the operating floor.
 - 1) Do not route through or over equipment removal areas, below monorails or cranes nor above or below hatches.
- 5. Expansion and vibration provisions:
 - a. Provide horizontal expansion loops at the process connections.
 - b. Route tubing parallel to relative motion through sleeved supports that allow linear tube movement.
 - c. Cold springing of tubing to compensate for thermal expansion is prohibited.
 - d. Utilize flexible hoses to connect pneumatic tubing to air users which may move or vibrate.
- I. Air Supply:
 - 1. Connect all instruments requiring air to air supply piping and tubing.
 - 2. Provide connections as follows:
 - a. Terminate branch supply line not more than 36 IN from the device with a 1/2 IN isolation valve.
 - b. For remaining line, use 1/4 or 3/8 IN tubing of a length to allow for normal equipment movement and vibration.
 - c. Use flexible hoses to connect pneumatic tubing to air users which may experience significant movement or vibration.
 - d. Make branch connections to individual instruments from the top of the supply header.
 - e. Purge instrument air piping of extraneous material by blowing clean, dry, oil-free air through the system prior to final connection.
- J. Threaded Connection Seals:
 - 1. Use Tite-Seal or acceptable alternate.
 - 2. Use of lead base pipe dope or Teflon tape is not acceptable.
 - 3. Do not apply Tite-Seal to tubing threads of compression fittings.

- K. Capillary Tubing:
 - 1. Route capillary tubing in tubing tray.
 - 2. Install capillary tubing with a 2 IN minimum bend radius which does not kink or pinch the capillaries.
 - 3. Do not cut or disconnect at any point.
 - 4. Coil excess capillary tubing and secure at the instrument.
- L. Temperature Elements:
 - 1. Assemble in the following sequence:
 - a. Remove temperature sensor sheaths and terminal blocks from the head and nipple assembly.
 - b. Connect nipple and head to thermowell installed in the pipe.
 - c. Insert sheath and terminal block until it seats in the thermowell.
 - d. Connect to the head.
- M. Instrument Mounting:
 - 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
 - 2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
 - 3. Mount instruments level, plumb, and support rigidly.
 - 4. Mount to provide:
 - a. Protection from heat, shock, and vibrations.
 - b. Accessibility for maintenance.
 - c. Freedom from interference with piping, conduit and equipment.
- N. Instrument Configuration and setup
 - 1. Instrumentation shall be configured and ready for integration into the SCADA system.
 - 2. All instrumentation configuration shall be completed by the Contractor.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 40 94 43
PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Programmable logic controller (PLC) control system(s), including software, programming, and training.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment: Basic Requirements.
 - 4. Section 10 14 00 - Identification Devices.
 - 5. Section 26 05 19 - Conductors and Communications Cabling.
 - 6. Section 40 90 00 - Instrumentation for Process Control: Basic Requirements.
 - 7. Section 40 90 05 - Control Loop Descriptions.
 - 8. Section 40 98 00 - Control Panels and Enclosures.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C37.90.2, Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
 - b. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. ICS 1, General Standards for Industrial Control and Systems.
- B. Qualifications:
 - 1. Installation supervisor shall have had experience in overseeing installation and startup of at least three (3) similar installations.
 - 2. Programmer(s) shall have had experience in programming PLCs for at least two (2) projects of similar size and complexity.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 90 00.
 - 3. Product technical data including:
 - a. Annotated hard copies of PLC software programs.
 - 1) Submit program for logic in ladder diagram format as used for the specific PLC system.
 - 2) Annotate program listing to include the following:
 - a) Written description of each rung's function.
 - b) Reference to control loop number for each rung where applicable.
 - c) Reference to instrumentation tag number of I/O devices for each rung where applicable.
 - 3) Provide written descriptions completely defining all function blocks used in program.
 - 4) Provide list of all addresses referenced in logic diagram with description of data associated with each address.
 - b. Results of factory testing procedures.

- c. Drawings containing the following information to be submitted as part of Specification Section 40 98 00 submittals:
 - 1) Arrangement drawings for PLC system components.
 - 2) Panel and enclosure plans, sections and details.
 - 3) Access opening locations and required clearances for each panel and enclosure.
 - 4) Enclosure internal wiring and terminal blocks.
- d. Catalog cut sheets containing information on PLC components to be submitted as part of this Specification Section submittals.
- 4. Certifications:
 - a. Qualifications of installation supervisor.
 - b. Qualifications of programmer(s).
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - 2. Submit maintenance procedures available to Owner.
 - a. Include the location and phone numbers of service centers (including 24 HR "hot lines").
 - b. Provide specific information including operation and maintenance requirements, programming assistance, troubleshooting guide, parts ordering, field service personnel requests, and service contracts.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Rockwell Automation, Allen-Bradley.
 - 2. Or approved equal
- B. The existing Process Instrumentation and Control Systems (PICS) design and associated native Ethernet IP network protocol is based on the existing plant Rockwell Automation platform. Network standardization is required to maximize operational efficiency and effectiveness, and minimize network operational costs.
 - a. All new equipment connected to PICS via Ethernet shall utilize native Ethernet IP protocol. The term “native” used in this context means that the protocol is integral to the equipment—a converter or gateway to convert from one protocol to another (e.g., Modbus Plus to Ethernet IP) is not required. *The use of protocol converters and gateways for substitute equipment is not acceptable.*
 - b. All proposals for substitute products shall demonstrate equipment compatibility with existing software and hardware systems, replacement parts requirements, and training requirements. The bid price of the proposed substitute products shall include:
 - 1) 8 hours of training (in addition to that specified herein) for Owner operations personnel
 - 2) Spare parts (for each type/size) including control and power boards or modules, operator interface units, and communication and input/output modules
 - 3) PICS modification design, programming, and integration costs required to accommodate the proposed substitute.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. See Specification Section 40 90 00.
- B. The PLC system shall accomplish the control requirements of the loop descriptions, Drawings, and Specifications.

- C. PLC programming shall be documented and factory tested.
- D. The PLC system shall operate in ambient conditions of 32 to 140 DegF temperature and 5 to 95 percent relative humidity without the need for purging or air conditioning.
- E. Environmental Controls:
 - 1. Furnish circulation fans in solid state control system enclosures.
 - 2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.
 - 3. Air conditioning applications shall include means of preventing moisture condensation.
- F. Where the PLC is utilized to control multiple trains of equipment and where the equipment in each train operates as a unit relatively independent of other equipment trains (e.g., facility with multiple boiler units or filter trains), the PLC components (I/O modules, power supplies, etc.) shall be assigned so that the failure of any one (1) component does not affect equipment on all trains.
 - 1. I/O modules shall be segregated on a train basis unless required otherwise for safety reasons.
 - 2. Where several equipment units operate in parallel, but are not considered assigned to a particular equipment train (e.g., multiple raw water pumps or chemical feed pumps all discharging into a common system), the PLC I/O modules associated with each equipment unit shall be assigned so that the failure of any one (1) I/O module does not affect all of the parallel operating equipment units.
- G. All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per IEEE C37.90.2.
- H. Incorporate the following minimum safety measures:
 - 1. Watchdog function to monitor:
 - a. Internal processor clock failure.
 - b. Processor memory failure.
 - c. Loss of communication between processor and I/O modules.
 - d. Processor ceases to execute logic program.
 - 2. Safety function wiring: Emergency shutdown switches shall not be wired into the controller.
 - 3. Safe wiring:
 - a. Unless otherwise specified, activation of alarms and stopping of equipment shall result from the de-energization of control circuits, rather than the energization of control circuits.
 - b. Low voltage control signal wires:
 - 1) Place in conduit segregated for that purpose only.
 - 2) Twisted shielded wire pair.
 - 3) Not located in the same conduit or bundle with power wiring.
 - 4. Initial safety conditions:
 - a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.
 - b. Utilize program each time PLC is re-initiated and the control program activated.
 - 5. Monitoring of internal faults and display:
 - a. Internal PLC system status and faults shall be monitored and displayed.
 - 1) Monitored items shall include:
 - a) Memory ok/loss of memory.
 - b) Processor ok/processor fault.
 - c) Scan time overrun.
 - 6. Control of programs: Protect access to PLC program loading with password protection or with locked, key operated selector switches.

7. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.
8. Operator intervention:
 - a. Logic system failure shall not preclude proper operator intervention.
 - b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

2.3 COMPONENTS

- A. PLC System Communications Processor:
 1. The Communications Processor shall provide communications with the PLC Central Processor, other control systems, and man-machine interfaces as specified.
- B. PLC System Enclosure:
 1. In accordance with Specification Section 40 98 00.
 2. Wiring and grounding to be in accordance with Specification Section 40 98 00.
 3. Termination requirements:
 - a. In accordance with Specification Section 40 98 00.
 - b. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure.
 - c. Prewire I/O modules to terminal blocks.
 - d. Size terminals to accommodate all active database points and spares.
 - e. Provide terminals for individual termination of each signal shield.
 - f. Field wiring shall not be disturbed when removing or replacing an I/O module.
- C. PLC System Software and Programming:
 1. Provide all hardware and programming required to provide communication between the PLC and the man-machine interface.
 2. Provide programming to accomplish all control and monitoring requirements of the Drawings and Specifications.
 3. Provide two (2) copies of control logic program on thumb drive.
 4. Full documentation capability.
 - a. Provide description for each rung.
 5. On/off line programming.
 6. Offline simulation prior to download.
 7. Two-step commands requiring operator verification prior to deletion of any programming.

2.4 ACCESSORIES

- A. Provide all accessories required to furnish a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.5 SOURCE QUALITY CONTROL

- A. Provide a performance test after factory completion and prior to shipment.
 1. Conduct a test where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, and on/off sequencing control.
 2. Conduct testing with dummy I/O to verify each control loop operation.
 3. Allow for Owner and Engineer representatives to witness testing program.
 - a. Provide minimum of 15 days notice prior to testing.
 4. Do not ship prior to successful completion of this testing program.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install PLC control system in accordance with manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

- A. Employ and pay for services of field service representative(s) to:
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise adjustments and installation checks.
 - 3. Maintain and submit an accurate log of all commissioning functions.
 - a. All commissioning functions may be witnessed by the Engineer.
 - b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.
 - 4. Conduct startup of equipment and perform operational checks.
 - 5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.3 DEMONSTRATION

- A. Demonstrate system in accordance with Specification Section 01 75 00.

END OF SECTION

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SECTION 40 96 52

CONFIGURATION REQUIREMENTS: HUMAN MACHINE INTERFACE (HMI) AND REPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Configuration requirements for HMI and reports which includes but is not necessarily limited to.
 - a. Specific software functional descriptions.
 - b. Graphics requirements.
 - c. HMI functionality requirements.
 - d. Plant overview screens.
 - e. Process overview screens.
 - f. Detail displays.
 - g. Trend displays.
 - h. PLC hardware/HMI status screen.
 - i. Alarm monitoring.
 - j. Report generation.
 - k. Configuration standards and conventions.
 - l. Screen configuration review meetings.
 - m. Report configuration review meetings.
 - n. Coordination.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 40 90 00 - Instrumentation for Process Control: Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Qualifications:
1. Programmer(s) shall have had experience in software configuration and installation for at least two (2) projects of similar size and complexity.
- B. Standards:
1. The International Society of Automation
 - a. ISA – 101.01 Human Machine Interfaces for Process Automation Systems

1.3 DEFINITIONS

- A. HMI: Human Machine Interface.
- B. I/O: Input/Output.
- C. OLE: Object Linking and Embedding, a document standard developed by Microsoft that enables the creation of an object with one application and the linking or embedding of the object in a second application.
- D. OPC: "OLE for Process Control"; a software standard utilizing a client/server model that makes interoperability possible between automation/control applications and field systems/devices.
- E. PC: Personal Computer.
- F. PLC: Programmable Logic Controller.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 90 00.
 - 3. Software Configuration Standards and Conventions document.
 - 4. Graphic screen displays; provide in actual colors utilized.
 - 5. Sample reports.
 - 6. Certifications:
 - a. Qualifications of programmer(s).
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - 2. Software Configuration Standards and Conventions - final version.
- C. Informational Submittals:
 - 1. Results of factory testing procedures.
 - 2. Proposed training agendas and schedule.

1.5 GENERAL FUNCTIONAL REQUIREMENTS

- A. Software Functional Requirements:
 - 1. General functional requirements for system configuration are indicated on the Drawings and described in the Specifications.
 - 2. The information presented herein and indicated on the Drawings illustrates the general functional intent of the system and may not be sufficient to fully configure the system.
 - 3. The Contractor is responsible for determining what additional information may be required to complete the configuration tasks, and for obtaining this information from the Owner.
- B. The existing Process Instrumentation and Control Systems (PICS) design and associated native Ethernet IP network protocol is based on the existing plant Rockwell Automation platform. Network standardization is required to maximize operational efficiency and effectiveness, and minimize network operational costs.
 - a. All new equipment connected to PICS via Ethernet shall utilize native Ethernet IP protocol. The term “native” used in this context means that the protocol is integral to the equipment—a converter or gateway to convert from one protocol to another (e.g., Modbus Plus to Ethernet IP) is not required. *The use of protocol converters and gateways for substitute equipment is not acceptable.*
 - b. All proposals for substitute products shall demonstrate equipment compatibility with existing software and hardware systems, replacement parts requirements, and training requirements. The bid price of the proposed substitute products shall include:
 - 1) 8 hours of training (in addition to that specified herein) for Owner operations personnel
 - 2) Spare parts (for each type/size) including control and power boards or modules, operator interface units, and communication and input/output modules
 - 3) PICS modification design, programming, and integration costs required to accommodate the proposed substitute.
- C. Available Process Values:
 - 1. All process alarm, equipment status, and process variable values shall be available at any HMI.
 - 2. If communications to a particular I/O point has failed for any reason, then wherever that data is displayed, the software shall post a visual indication that the point is not valid.

- D. Provide comprehensive on-line help for all development functions.
- E. Manual Entry of Data:
 - 1. All PC-based HMIs must allow manual entry of surrogate data and other variables, which must then be available for display and use in reports.
 - a. Operator-entered commands from any of the operator workstations must be logged by the computer servers.
- F. System Failure:
 - 1. Failure of any PLC, remote I/O hardware, or network communication link must be individually alarmed at HMIs.
 - 2. Unless otherwise specified, each alarm must be specific to a single point of failure.
- G. Existing software licensing shall be modified as indicated on the Network Diagram and a violation in licensing shall not result with the addition of new plant HMIs.
- H. All process related functions, calculations, timers, and numeric manipulations, shall be accomplished in the PLC hardware and not in the HMI.
 - 1. The HMI shall function as a monitoring system, not as a process controller.
 - 2. The HMI shall transfer data to the PLC system and the PLC system shall perform all control algorithms.

1.6 SECURITY

- A. Fully integrate security into the SCADA system to allow only users with appropriate security levels access to individual parts of the system.

PART 2 - PRODUCTS

2.1 SPECIFIC SOFTWARE FUNCTIONAL DESCRIPTIONS

- A. Specific functional requirements for various software control blocks within the computer system are as follows.
- B. Descriptions are general and are not intended to fully indicate the complete functionality of the system.
 - 1. Monitoring of process values:
 - a. Process values derived from analog process variable signals must be historically archived.
 - 1) Store all historical data with time and date of occurrence.
 - 2) Make values available for use in reports.
 - 3) Assign high and low alarms to process values as defined below and otherwise deemed appropriate.
 - b. Provide capability for computer server(s) to retrieve real-time values from the PLC system at adjustable time periods.
 - c. Alarm limits:
 - 1) Set per direction from the Owner and spec section 40 90 05.
 - 2) An operator having proper security authorization must be able to enable, disable, and adjust the setpoint of any individual alarm.
- C. Modify existing graphic screen displays at SCADA to provide monitoring and control functionality of new processes and equipment.
 - 1. Hierarchy of HMI screens is in descending order as follows:
 - a. Plant overview screen(s).
 - b. Process overview screens.
 - c. Process screens.
 - d. Pop-up/control screens.
- D. SCADA operator interface functionality shall include:
 - 1. Indication of process variables.

2. Configuration of control loop parameters (e.g., setpoints, gains, etc.).
 3. Adjustment of controller output.
 4. Display of real time and historical process trends.
 5. Selector switch and pushbutton station controls.
 6. System and process status indicators.
 7. Graphic representation of plant operations with interactive status and measurement symbols.
 8. Annunciation.
- E. Graphics:
1. Utilize dynamic variables with unique tags per graphic.
 2. Dragging the mouse over designated process areas of screen shall allow the operator to select predetermined processes or equipment and drill down to site-specific detail screens.
 3. Critical "overview" information such as tank levels, flows and pressures shall be indicated through data fields or animation effects such as level fills or color change.
 4. All monitored and or controlled process equipment shall indicate status changes.
 - a. For example, a pump "running" condition shall be indicated differently than a pump that is "not running."
 5. Tank and vessel levels shall be indicated with a tabular data field and by a scaled analog graphic with a real time trend indicating a rising or falling level within the tank or vessel. The same Graphic shall also include scaled alarm points to provide an understanding of abnormal conditions approaching alarm levels.
 6. Provide the ability to "drill down" to detail screens or graphics.
 - a. Clicking on a device or process area shall generate a detail graphic or pop-up window to access specific data or control functions.
 - b. All operator adjustments (e.g., set point adjustment, mode selection) shall be accomplished via a pop-up display, and shall not be allowed on the process screen.
 7. Standard symbol library:
 - a. Must follow already established standards used at the plant.
 - b. User defined.
 - c. Must not require software programming.
 8. Single keystroke access from graphic to group display or other custom graphic displays.
 9. Capable of being edited by moving, copying, or grouping user defined areas of screen.
 10. Utilize a navigation bar.
 - a. Navigation bar utilized on every screen.
 - b. Navigation bar to include navigation functions, active alarm notification, security functions, current date/time display, "PRINT SCREEN" pushbutton, and other functions as required and as agreed upon at the Screen Configuration Review Meetings. The displays shall be animated as necessary to clearly convey equipment status, operation modes, process displays, alarms, etc.
- F. Process Overview Screens:
1. At a process overview screen, the operator shall be able to select a specific process screen for monitoring/control purposes.
 - a. Monitoring and control functions available at the selected process screen include but are not limited to the following:
 - 1) Select individual equipment items for monitoring and control.
 - 2) Select a control loop or point for control action.
 - 3) Change control mode of loop selected (manual, automatic, cascade).
 - 4) Change setpoint.
 - 5) Issue commands to start/stop and open/close two-state equipment.
 - 6) For manual loading output stations, the operator shall be able to manipulate analog output values.
 - 7) Select a loop and initiate further display, such as the detail display, trend, or hourly averaging.
 - 8) Display and change ratio and bias values.
 - 9) Control field equipment such as motor-operated valves and switches.

- 10) In general, any timer, setpoint values, or other control parameter that could be changed during commissioning testing or normal operations should be made available to the Operator. Password protection should be required to make changes.
- 11) Entries made by the operator (such as operation modes, setpoints, etc.) shall be displayed on the process screens for information. All entries and changes shall be tracked in an event log.
- 12) The PLC shall keep track of daily equipment run-times. The run-time values shall be automatically reset once a day, at 8:30 am after the values have been automatically recorded.

G. Process Screens:

1. The Process Screens shall be developed to show the full status for each piece of equipment within the process displayed. The color of the equipment shall vary as well as a text indicator to show the status of each valve, pump, etc. All analog values associated with the process HVACs displayed shall be shown. Each piece of equipment which can be controlled shall be "active" and allow the operator to click on the equipment and bring up a pop-up equipment control detail screen. There shall be three buttons in the same location at the bottom of each process screen to move back to the plant overview screen, the alarm screen, and the trend screen.

H. Equipment control detail pop-up:

1. Utilize existing plant standards to develop a set of standard equipment control detail pop-ups to be used for each type of equipment controlled from the OIS. Each pop-up shall include a DONE button which hides the pop-up when done. Equipment symbol elements in the pop-up shall be animated to show when the equipment changes state to the command state.

I. Detail Display:

1. Provide separate display for each point.
 - a. Representations of each analog and digital point shall be single user configured faceplate.
 - b. Display shall include alphanumeric representations of all variables and parameters for single loops including but not limited to:
 - 1) Alarm points.
 - 2) Limits.
 - 3) Constants.
 - 4) Interconnections to other loops.
 - 5) Calculating functions.

J. Trend Displays:

1. Real time historical trend displays.
2. Real time on-line trend displays.
3. Capable of displaying multiple points per display.
4. Operator shall be able to select any desired sample time interval.
5. Provide flexibility and easy access to real time and historical trend information for any variable TAG defined within the SCADA application.
 - a. As a minimum, provide the following:
 - 1) Provide capability for the user to define trend scenarios.
 - 2) Provide a button to open a dialog window to select multiple variable TAGS and save them as a trend scenario for future use.
 - 3) Provide a pull-down menu to allow the user to open saved trend scenarios.
 - 4) Provide a button to allow the user to select real-time or historical trends.
 - 5) Provide a button to save displayed trend info to a file for export to external software applications (such as Microsoft Excel).
 - 6) Provide a Print Trend button to allow user to print current trend.
6. Utilize Historical DataServer(s) to collect and manage data. At a minimum equipment run times, electrical characteristics and instrumentation values shall be logged.

- K. PLC Hardware/HMI Status Screen:
 - 1. Provide a status screen to depict status conditions and diagnostic information for all major networked equipment.
 - 2. Depict communication status for all networked communicating devices, such as PLC processors, Ethernet switches, PCs, and radios.

- L. Alarm Monitoring:
 - 1. Provide standard alarm screen functionality to ensure flexibility and quick access to live alarms, alarm history and alarm grouping parameters.
 - a. As a minimum, include the following features and functionality:
 - 1) An Alarm Screen header bar to head all alarm pages and reside below the Navigation Bar.
 - 2) Buttons to dynamically switch between Alarm Summary and Alarm History.
 - 3) A menu to allow user to select and open historical alarm archives.
 - a) Utilize a time-date stamp file structure.
 - 4) Pull-down menu bar to select operator configured alarm groups.
 - 5) Capability to sort alarms by priority and to define priority for all system alarms.
 - 6) Capability to filter or group alarms.
 - 2. Analog alarms:
 - a. The SCADA software shall monitor analog and discrete variables and calculated conditions, and determine if the variable is in an alarm condition.
 - b. For each Analog Tag, an alarm for each of the following conditions shall be assignable:
 - 1) Low-low.
 - 2) Low.
 - 3) High.
 - 4) High-high.
 - 5) Deviation low.
 - 6) Deviation high.
 - 7) Rate of change.
 - c. Provide adjustable dead bands and delay timers for all analog alarms.
 - 3. Present alarms in order of:
 - a. Priority.
 - b. Time of occurrence.
 - c. Non-acknowledged presented ahead of acknowledged.
 - 4. Utilize single keystroke or pushbutton to:
 - a. Acknowledge alarms.
 - 5. Alarm list presented to operator shall include:
 - a. Time of occurrence.
 - b. Time of acknowledgement.
 - c. Description.
 - d. Acknowledgement status.
 - 6. Alarm list printed by either of the following:
 - a. On command.
 - b. Periodically.
 - 7. Audible alarming capability for user selected alarms.

- M. Report Generation:
 - 1. Base bid on the generation of the following reports:
 - a. Minimum of two formatted reports.
 - 1) Report form and content shall be determined at the Report Configuration Review Meetings.
 - 2) Each report shall contain daily, weekly, and monthly average calculated values.
 - 3) Each report shall contain between three and ten measured parameters.
 - b. List of all entries initiated by operator including the following:
 - 1) Console key changes.
 - 2) Beginning and final values of setpoint and output changes.

- 3) Mode changes (i.e., auto to manual).
- 4) Time change was made.
- c. Event list:
 - 1) Description of selected events.
 - 2) Time of event.
- 2. Custom report capabilities:
 - a. User configurable.
 - b. Contain selected information from any log, event, or alarm list.
 - c. Capable of producing custom log report for periodic and on-demand printing of a list of process or calculated variables.
 - d. Reports shall not require software programming by the user to setup.
- 3. Control of programs:
 - a. Protect access to configuration via password protection.

PART 3 - EXECUTION

3.1 CONFIGURATION REQUIREMENTS

- A. Provide all programming modifications and configurations required for SCADA.

3.2 CONFIGURATION STANDARDS AND CONVENTIONS

- A. It is the intent of these specifications to provide the end user with state-of-the-art functionality.
 - 1. Minimum standards are as follows:
 - a. Depict the actual process equipment configuration as accurately as possible.
 - 2. All overview and site-specific screens shall incorporate a "navigational header bar."
 - a. The intention of this Specification is to provide a familiar, user-friendly navigation throughout the graphical displays.

3.3 SCREEN AND REPORT CONFIGURATION REVIEW MEETINGS

- A. Conduct a minimum of one configuration conferences with the Owner to review and discuss system configuration programming and related topics.
 - 1. The purpose of the conferences will be to discuss, in detail, how each I/O point will be handled and the types, quantities, hierarchies, and functioning of display screens.
 - 2. Review of the Owner's existing systems, standards, conventions, file and tag naming requirements, font type and size requirements, and reporting requirements must be part of each conference.
 - 3. Review the navigation bar to be utilized.
 - 4. Review of the Owner's existing systems, standards, conventions, and reporting requirements must be part of each conference.
 - 5. Bring equipment to project screens on wall or provide multiple monitors for viewing by attendees.

3.4 COORDINATION

- A. Coordinate as required with other contractors and vendors to seamlessly integrate all HMI monitoring and control functions.
 - 1. To the greatest extent possible, integrate graphics presentation for all systems into screens utilizing one common HMI software.
- B. Examples of systems that utilize separate application software packages and thus require coordination include, but are not necessarily limited to:
 - 1. Generator Controls.
 - 2. Digital Metering Package.
 - 3. Distributed UPS System.
 - 4. Pre-purchased control systems: Press system, Duplex pumping station

3.5 FIELD QUALITY CONTROL

- A. Employ and pay for services of field service representative(s) to:
 - 1. Inspect equipment covered by this Specification Section.
 - 2. Supervise adjustments and installation checks.
 - 3. Maintain and submit an accurate daily or weekly log of all commissioning functions.
 - a. All commissioning functions may be witnessed by the Engineer.
 - b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.
 - 4. Conduct startup of equipment and perform operational checks.
 - 5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.6 DEMONSTRATION

- A. Demonstrate system in accordance with Specification Section 01 75 00.
 - 1) Provide On-Site Training in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 40 97 00
CONTROL AUXILIARIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Signal modules:
 - a. Loop isolator.
 - b. Potentiometer transmitter.
 - c. Pneumatic/current transducer.
 - 2. Pilot devices:
 - a. Selector switches.
 - b. Pushbuttons.
 - c. Indicating lights.
 - d. Combination selector switch/indicator light.
 - e. Potentiometer
 - 3. Relays/timers:
 - a. Control relay.
 - b. Time delay relays.
 - 4. Termination equipment:
 - a. Terminal blocks.
 - b. Fuse holders.
 - 5. Voltage surge protection devices.
 - 6. Running time indicator.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 04 – Basic Electrical Materials and Methods.
 - 4. Section 40 90 00 - Instrumentation for Process Control: Basic Requirements.
 - 5. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. The International Society of Automation (ISA):
 - a. S18.1, Annunciator Sequences and Specifications.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - 3. Underwriters Laboratories, Inc. (UL).
- B. Miscellaneous:
 - 1. Assure units comply with electrical area classifications and NEMA enclosure type shown on Drawings.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 90 00.

- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 – Operation and Maintenance Manuals for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Provide similar components from the same manufacturer for uniformity of appearance, operations, and maintenance.
- C. Submit request for substitution in accordance with the General Conditions and Specification Section 01 25 00.

2.2 SIGNAL MODULE

- A. Loop Isolators:
 - 1. Acceptable manufacturers:
 - a. AGM Electronics.
 - b. Moore Industries.
 - c. Or approved equal
 - 2. Design and fabrication:
 - a. Solid state electronics.
 - b. Transmit analog output signal directly proportional to measured input signal.
 - c. Power source: 24 Vdc.
 - d. Analog input: 4-20 mA DC or 1-5 Vdc.
 - e. Output signal: 4-20 mA DC into 1400 ohms.
 - f. Impedance:
 - 1) Voltage input: 10 Meg.
 - 2) Current input: 50 ohms.
 - 3) Voltage output: 1 ohm.
 - 4) Current output: 1650 ohms.
 - g. Accuracy: Better than ± 0.10 percent of span.
 - h. Isolation: Up to 500 V rms (input, output and case).
 - i. Temperature effect: ± 0.0025 percent of span per DegF.
 - j. Ambient temperature range: 0-140 DegF.
 - k. Factory calibrated.
- B. Potentiometer Transmitters:
 - 1. Acceptable manufacturers:
 - a. Transmation, Inc.
 - b. Moore Industries.
 - c. AGM Electronics.
 - d. Or approved equal
 - 2. Design and fabrication:
 - a. Solid state electronics.
 - b. Transmit analog signal directly proportional to measured impedance input.
 - c. Power source: 24 Vdc.
 - d. Input: 0-1000 ohms.
 - e. Output signal: 4-20 mA DC.
 - f. Accuracy (maximum error): ± 0.25 percent.
 - g. Ambient temperature range: 0-140 DegF.

- C. Current/Pneumatic Transducer:
 - 1. Acceptable manufacturer:
 - a. Fisher Controls.
 - b. Or approved equal.
 - 2. Materials:
 - a. Housing: Cast aluminum or fiberglass.
 - 3. Design and fabrication:
 - a. Force balance device.
 - b. Capable of receiving an electronic signal and converting it to a directly proportional pneumatic signal.
 - c. Input signal: 4-20 mA DC.
 - d. Output signal: 3-15 psi.
 - e. Accuracy (maximum error): +0.50 percent of output span.
 - f. Ambient temperature range: 0-140 DegF.

2.3 PILOT DEVICES

- A. Selector Switches:
 - 1. Acceptable manufacturers:
 - a. Allen-Bradley.
 - b. Eaton.
 - c. Or approved equal.
 - 2. Design and fabrication:
 - a. Heavy-duty type.
 - b. NEMA 4/13 or 4/4X/13 as required.
 - c. Rotary cam units conforming to NEMA ICS 2-216.22.
 - d. Mounting hole: 30.5 mm with key to avoid rotation in hole.
 - e. Supply switches having number of positions required with contact blocks to fulfill functions shown and specified.
 - f. UL listed.
 - g. Maintained contact type with a positive detent to prevent the switch from hanging up between positions.
 - h. Knob type operators.
 - i. Black colored operators.
 - j. Designed with cam and contact block.
 - k. Legend plate marked per Contract Documents.
 - l. Contact block requirements:
 - 1) Dry and indoor locations: Standard finger safe contact blocks rated for 10 A continuous current.
 - 2) Wet or outside locations: Hermetically sealed contact blocks.
- B. Pushbuttons:
 - 1. Acceptable manufacturers:
 - a. Allen-Bradley.
 - b. Eaton.
 - c. Or approved equal.
 - 2. Materials:
 - a. Backing diaphragm: Buna-N.
 - 3. Design and fabrication:
 - a. Heavy-duty type.
 - b. NEMA 4/13 or 4/4X/13 as required.
 - c. Conforming to NEMA ICS 2-216.22.
 - d. Mounting hole: 30.5 mm.
 - e. Diaphragm backed.
 - f. UL listed.
 - g. Emergency stop pushbuttons to have mushroom head operator and maintained contact.

- h. Non-illuminated type:
 - 1) Momentary contact with necessary contact blocks.
 - 2) Molded, solid color melamine buttons.
 - 3) Standard flush operators.
 - 4) Black colored buttons for START or ON and black color for STOP or OFF.
 - 5) Appropriate contact blocks to fulfill functions shown or specified.
 - i. Contact block requirements:
 - 1) Dry and indoor locations: Standard finger safe contact blocks rated for 10 A continuous current.
 - 2) Wet or outside locations: Hermetically sealed contact blocks.
 - 3) Legend plate marked per Contract Documents.
 - j. Illuminating type:
 - 1) Momentary contact with necessary contact blocks.
 - 2) Serves as both pushbutton control and indicating light.
 - 3) Green colored lenses for start or on and red for STOP or OFF.
 - 4) Resistor-type full voltage light unit with lens and panel gasket.
 - 5) Legend plate marked per Contract Documents.
 - 6) Appropriate contact blocks to fulfill functions shown or specified.
- C. Indicating Lights:
- 1. Acceptable manufacturers:
 - a. Allen-Bradley.
 - b. Eaton.
 - c. Or approved equal
 - 2. Design and fabrication:
 - a. Heavy duty.
 - b. NEMA 4/13 or 4/4X/13 as required.
 - c. LED.
 - d. UL listed.
 - e. Legends marked per Contract Documents.
 - f. Mounting hole: 30.5 mm.
 - g. Push-to-test indicating lights.
 - h. Glass lens.
 - i. Color code lights as follows:
 - 1) Green: ON or running; valve normal.
 - 2) Amber: Standby; auto mode; ready.
 - 3) Red: OFF or stopped; valve abnormal.
 - j. Legend plate engraved for each light.
- D. Combination Selector Switch/Indicator Light:
- 1. Acceptable manufacturer:
 - a. Allen Bradley.
 - b. Eaton.
 - c. Or approved equal.
 - 2. Design and fabrication:
 - a. Indicators, pushbuttons, selectors, and selector-push combination units as indicated on Drawings.
 - 1) Contact arrangements and functions as shown on Drawings.
 - b. Integrally-mounted transformers for each indicating lamp.
 - 1) Lens colors and engravings as shown on Drawings.
 - c. NEMA 4/13 or 4/4X/13 as required.
 - d. Cover plate edge bezel: Chrome colored to match existing.
 - e. Contacts: Heavy-duty rated with easy wiring terminal screws.
- E. Potentiometer:
- 1. Acceptable manufacturers:

- a. Allen Bradley.
- b. Eaton.
- c. Or approved equal
- 2. Design and fabrication:
 - a. Heavy-duty, NEMA type.
 - b. Mounting hole: 30.5 mm.
 - c. UL listed.
 - d. Linear adjustment through 0-1000 ohms with 1 percent resolution.
 - e. 3-wire interface.
 - f. Dial plate with 0-100 percent scale.
 - g. Panel mounted.
 - h. One-turn adjustment knob.

2.4 RELAYS/TIMERS

A. Control Relays:

- 1. Acceptable manufacturers:
 - a. Allen-Bradley
 - b. Phoenix Contact
 - c. Or approved equal
- 2. Design and fabrication:
 - a. Plug-in general purpose relay, tube base.
 - b. Pin connector type.
 - c. Switching capacity: 10 A.
 - d. Contact material: Silver cadmium oxide.
 - e. Provide relays with a minimum of 3 SPDT contacts.
 - f. Coil voltage: 120 Vac or 24 Vdc.
 - g. Relay sockets are DIN rail mounted with guarded terminal.
 - h. Internal neon or LED indicator is lit when coil is energized.
 - i. Clear polycarbonate dust cover with clip fastener.
 - j. Check button.
 - k. Temperature rise:
 - 1) Coil: 85 DegF max.
 - 2) Contact: 65 DegF max.
 - l. Insulation resistance: 100 Meg min.
 - m. Frequency response: 1800 operations/hour.
 - n. Operating temperature: -20 to +150 DegF.
 - o. Life expectancy:
 - 1) Electrical: 500,000 operations or more.
 - 2) Mechanical: 50,000,000 operations or more.
 - p. UL listed or recognized.

B. Time Delay Relays:

- 1. Acceptable manufacturers:
 - a. Allen Bradley.
 - b. Phoenix Contact.
 - c. Or approved equal
- 2. Design and fabrication:
 - a. Melt design test and performance requirements of NEMA ICS 2-218.
 - b. Heavy-duty.
 - c. Solid-state construction.
 - d. External adjusting dial.
 - e. Auxiliary relays as required to perform functions specified or shown on Drawings.
 - f. Operates on 117 Vac (± 10 percent) power source.
 - g. Contact rating: A150 per NEMA ICS 2-125.
 - h. Furnish with "on" and "timing out" indicators.

2.5 TERMINATION EQUIPMENT

- A. Terminal Blocks:
 - 1. Acceptable manufacturers:
 - a. Allen Bradley.
 - b. Phoenix Contact.
 - c. Or approved equal
 - 2. Design and fabrication:
 - a. Modular type with screw compression clamp.
 - b. Screws: Stainless steel.
 - c. Current bar: Nickel-plated copper allow.
 - d. Thermoplastic insulation rated for -40 to +90 DegC.
 - e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
 - f. Install end sections and end stops at each end of terminal strip.
 - g. Install machine-printed terminal markers on both sides of block.
 - h. Spacing: 6 mm.
 - i. Wire size: 22-12 AWG.
 - j. Rated voltage: 600 V.
 - k. Din rail mounting.
 - l. UL listed.
 - 3. Standard-type block:
 - a. Rated current: 30 A.
 - b. Color: Gray body.
 - 4. Bladed-type block:
 - a. Terminal block with knife blade disconnect which connects or isolated the two (2) sides of the block.
 - b. Rated current: 10 A.
 - c. Color:
 - 1) Panel control voltage leaves enclosure - normal: Gray body, orange switch.
 - 2) Foreign voltage entering enclosure: Orange body, orange switch.
 - 5. Grounded-type block:
 - a. Electrically grounded to mounting rail.
 - b. Use to terminal ground wires and analog cable shields.
 - c. Color: Green and yellow body.
- B. Fuse Holders:
 - 1. Acceptable manufacturers:
 - a. Allen Bradley.
 - b. Phoenix Contact.
 - c. Or approved equal.
 - 2. Design and fabrication:
 - a. Modular-type with screw compression clamp.
 - b. Screws: Stainless steel.
 - c. Current bar: Nickel-plated copper alloy.
 - d. Thermoplastic insulation rated for -40 to +105 DegC.
 - e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
 - f. Blocks can be ganged for multi-pole operation.
 - g. Install end sections and end stops at each end of terminal strip.
 - h. Install machine-printed terminal markers on both sides of block.
 - i. Spacing: 8 mm.
 - j. Wire size: 30-12 AWG.
 - k. Rated voltage: 300 V.
 - l. Rated current: 12 A.
 - m. Fuse size: 5 x 20 mm.
 - n. Blown fuse indication.
 - o. DIN rail mounting.

p. UL listed.

2.6 VOLTAGE SURGE PROTECTION DEVICES

A. See Specification Section 26 43 13, Surge Protection Devices (SPD's) 1000V or Less.

2.7 RUNNING TIME INDICATORS

A. Acceptable Manufacturer:

1. Eagle Signal Controls.
2. Or approved equal.

B. Design and Fabrication:

1. Six-digit wheels including a 1/10 digit.
2. Non-reset type.
3. Time range in hours.
4. Automatic recycle at zero.
5. Accuracy: 1 percent.
6. Sealed against dirt and moisture.
7. Tamperproof.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 40 98 00
CONTROL PANELS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for control panels and enclosures utilized as follows:
 - a. Unless noted otherwise, all control panels and enclosures housing control components that are specified in Specification Section 26 05 00, Specification Section 40 91 10 or Specification Section 40 97 00.
- B. Related Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 10 14 00 - Identification Devices.
 4. Section 40 90 00 - Instrumentation for Process Control: Basic Requirements.
 5. Section 40 90 05 - Control Loop Descriptions.
 6. Section 40 91 10 - Primary Elements and Transmitters.
 7. Section 40 97 00 - Control Auxiliaries.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American National Standards Institute (ANSI).
 2. ASTM International (ASTM):
 - a. B75, Standard Specification for Seamless Copper Tube.
 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 4, Industrial Control and Systems: Terminal Blocks.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 409, Industrial Control Panels.
 5. Underwriters Laboratories, Inc. (UL):
 - a. 508A, Standard for Safety Industrial Control Panels.
 - b. 698A for Industrial Control Panels Relating to Hazardous Locations
- B. Miscellaneous:
1. Approved supplier of Industrial Control Panels under provisions of UL 508A.
 - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
 - b. Entire assembly shall be affixed with a UL 508A label "Listed Open Industrial Control Panel" prior to shipment to the jobsite.
 - c. Control panel(s) without an affixed UL 508A label shall be rejected and sent back to the Contractor's factory.
 - d. At the Owner's option, UL representatives shall perform a field inspection of the panel and place a UL placard on the panel after it satisfies UL 508A requirements.
 - e. All associated costs are to be paid by the Contractor.
 2. Schematics and Panel drawings contained within contract documents shall be used by the Contractor as shop drawings. Contractor shall provide As-built drawings to the Engineer for inclusion in the record documents. If panel drawings and schematics contained within the contract documents are not suitable for shop drawing use it is the responsibility of the Contractor to provide adequate shop drawings for the control panels being provided for the project per Section 1.4 of this specification.

1.3 DEFINITIONS

- A. Panel: Control panels or enclosures listed in the schedule included in this Specification Section.
- B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.
- C. Intrinsically Safe:
 - 1. A device, instrument or component that will not produce sparks or thermal effects under normal or abnormal conditions that will ignite a specified gas mixture.
 - 2. Designed such that electrical and thermal energy limits inherently are at levels incapable of causing ignition.
- D. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- E. Instrumentation Cable:
 - 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
 - 2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad), and is used for the transmission of low current or low voltage signals.
- F. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.
- G. Programmable Logic Controller (PLC): A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices.
- H. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.
- I. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.
- J. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.
- K. Highway Addressable Remote Transducer (HART): An open, master-slave protocol for bus addressable field instruments.
- L. Digital Signal Cable: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.
- M. Uninterruptible Power Supply (UPS): A backup power unit that provides continuous power when the normal power supply is interrupted.
- N. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and measuring 4-20ma DC analog signals.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process. Panel layout and schematics within contract documents for panels identified in the schedule are to be treated as shop drawings. All other items described below beyond the shop drawings are the responsibility of the Contractor.
 - 2. See Specification Section 40 90 00.
 - 3. According to UL508A requirements.
 - 4. Prepared with computer aided design (CAD) software.
 - 5. Printed on 11 by 17 IN sheets.

6. Drawings shall include a title block containing the following:
 - a. Plant or facility name where panel(s) are to be installed.
 - b. Drawing title.
 - c. Drawing number.
 - d. Revision list with revision number and date
 - e. Drawing date.
 - f. Drawing scale.
 - g. Manufacturer name, address, and telephone number.
7. Cover sheet for each drawing set shall indicate the following:
 - a. Plant or facility name.
 - b. Project name.
 - c. Submittal description.
 - d. Revision number.
 - e. Issue date.
8. Table of contents sheet(s) shall indicate the following for each drawing in the set:
 - a. Drawing title.
 - b. Drawing number.
9. A panel general data sheet shall indicate the following:
 - a. Panel construction notes including enclosure NEMA rating, finish type and color, wire type, wire color strategy, conductor sizes, and wire labeling strategy.
 - b. Confirmation that the panel(s) are to be affixed with a UL 508A label prior to shipment from the factory.
 - c. Panel materials of construction, dimensions, and total assembled weight.
 - d. Nameplate schedule with exact text, letter height and color, and background color.
 - e. Cautionary markings.
10. Bill of Materials shall indicate the following:
 - a. Where a Bill of Material is included as part of the Contract Documents, only required changes or additions to the Contact Documents to meet design intent shall be submitted.
 - b. Where a Bill of Material is required for a panel not included in the Contract Documents it shall include the following component information:
 - 1) Component item numbers.
 - 2) Quantity.
 - 3) Functional name or description.
 - 4) Manufacturer.
 - 5) Complete model number.
 - 6) Size or rating.
11. Panel exterior layout drawings shall indicate the following:
 - a. Where a Panel Exterior Layout is included as part of the Contract Documents, only required changes or additions to the Contact Documents to meet design intent shall be submitted.
 - b. Where a Panel Exterior Layout is required for a panel not included in the Contract Documents it shall include the following component information:
 - 1) Panel dimensions and dimensions of components relative to edges and other major components.
 - 2) Panel access openings.
 - 3) Component item numbers referenced to the Bill of Material.
 - 4) Conduit access locations.
 - 5) Front panel device layout.
 - 6) Nameplate location.
12. Panel interior layout drawings shall indicate the following:
 - a. Where a Panel Interior Layout is included as part of the Contract Documents, only required changes or additions to the Contact Documents to meet design intent shall be submitted.
 - b. Where a Panel Interior Layout is required for a panel not included in the Contract Documents it shall include the following component information:

- 1) Interior panel dimensions and dimensions of components relative to edges and other major components.
 - 2) Component item numbers referenced to the Bill of Material.
 - 3) Interior device layouts.
 - 4) Wire-way locations, purpose, and dimensions.
 - 5) Terminal strip designations.
 - 6) Location of lighting fixtures, switches and receptacles.
13. Wiring Schematics shall consist of the following:
- a. Where Wiring Schematics are included as part of the Contract Documents. Only required changes or additions to the Contract Documents to meet design intent shall be submitted.
 - b. Where Wiring Schematics are required for a panel not included in the Contract Documents it shall include the following component information:
 - 1) Panel power distribution diagrams including circuit protection and ratings.
 - 2) Internally wired components and equipment tags.
 - 3) Required field wiring, external components and equipment tags.
 - 4) I/O information:
 - a) Model number of I/O module.
 - b) Description of I/O module type and function.
 - c) Rack and slot number.
 - d) Terminal number on module.
 - e) Point or channel number.
 - f) Programmed point addresses.
 - g) Signal function and type.
 - 5) Wiring diagrams shall identify each wire as it is to be labeled.
- B. Manufacturer catalog cut sheets for enclosure, finish, panel devices, control auxiliaries, and accessories.
- C. Electrical load calculations for each panel:
1. Total connected load.
 2. Peak electrical demand for each panel.
- D. Climate control calculations for each panel.
1. Verify that sufficient dissipation and/or generation of heat is provided to maintain interior panel temperatures within the rated operating temperatures of panel components.
- E. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 2. See Specification Section 40 90 00.
- F. Informational Submittals:
1. Record Drawings:
 - a. Contractor shall provide updated panel drawings to the Engineer prior to shipping for record documents and inclusion in the record drawings
 - b. Updated panel drawings delivered with the panel(s) from the Contractor's factory.
 - c. Drawings shall be enclosed in transparent plastic and firmly secured within each panel.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Enclosures:
 - a. Hoffman Engineering Co.

- b. Rittal.
- c. Hammond Manufacturing.
- d. Or approved equal.
- 2. Panel heaters:
 - a. Hoffman Enclosures, Inc.
 - b. Rittal.
 - c. Hammond Manufacturing.
 - d. Or approved equal.
- 3. Heat exchangers and air conditioners:
 - a. Hoffman Enclosures, Inc.
 - b. Rittal.
 - c. Hammond Manufacturing.
 - d. Or approved equal.
- 4. Cooling fans and exhaust packages:
 - a. Hoffman Enclosures, Inc.
 - b. Rittal.
 - c. Or approved equal.
- 5. Feed through Terminals
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Or approved Equal
- 6. Miniature Circuit Breakers
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Or approved Equal
- 7. 24VDC Power Supplies
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Sola
 - d. Or approved Equal
- 8. Relay Coils
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Or approved Equal
- 9. UPS
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Or approved equal
- 10. Surge Suppressors
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Or approved Equal
- 11. Industrial Network Switch
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Moxa
 - d. Or approved Equal

B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 ACCESSORIES

- A. Panel Nameplates and Identification:
1. See Section 10 14 00-Identification Devices

2.3 FABRICATION

- A. General:
1. Fabricate panels with instrument arrangements and dimensions identified in the Contract Documents. All changes to the contract documents are to be approved by engineer, redlined and provided to the Engineer for as-built record documents.
 2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications identified in the Contract Documents.
 3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the panel enclosure rating.
 - a. Devices that cannot be obtained with an adequate NEMA rating shall be installed behind a transparent viewing window.
 - b. The window shall maintain the required NEMA rating of the enclosure.
 4. Panel(s) shall be completely assembled at the Contractor's factory.
 - a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite.
 5. Patching:
 - a. Existing enclosures that have been field modified shall be patched where indicated on the Drawings.
 - b. Holes in enclosure doors left by removed equipment shall be patched by welding a cover of the same size and shape in the opening. All welding beads on the exterior surface shall be ground smooth.
 - c. All patched exterior surfaces shall have the entire surface painted to ensure uniformity of faded existing paint.
 - d. Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
 - e. Utilize solvent or chemical methods to clean panel surfaces.
 - f. All bare metal on the interior and exterior surfaces shall be primed and painted.
 - g. Paint shall be ANSI #61 gray with flat finish.
 6. Painting:
 - a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted.
 - 1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
 - 2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
 - 3) Utilize solvent or chemical methods to clean panel surfaces.
 - 4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
 - 5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
 - 6) Bake powder coating at high temperatures to bond coating to enclosure surface.
 - a) Panel interior shall be white with semi-gloss finish.
 - b) Panel exterior shall be ANSI #61 gray with flat finish.
 - 7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 1 or NEMA 12 rated panels.
 - b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.
 7. Finish opening edges of panel cutouts to smooth and true surface conditions.
 - a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.
 8. Panel shall meet all requirements of UL 508A.

- a. If more than one (1) disconnect switch is required to disconnect all power within a panel or enclosure, provide a cautionary marking with the word "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one (1) disconnect switch required to de-energize the equipment before servicing."
 - 9. Provide control panel in accordance with NFPA 70, Article 409.
 - a. In the event of any conflict between NFPA 70, Article 409 and UL 508A, the more stringent requirement shall apply.
- B. Free-Standing Panels:
 - 1. Welded construction.
 - 2. Completely enclosed, self-supporting, and gasketed dust tight.
 - 3. Rolled lip around all sides of enclosure door opening.
 - 4. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
 - 5. Full height, fully gasketed flush pan doors.
 - 6. Full length piano hinges rated for 1.5 times door plus instrument weight.
 - 7. Doors with keyed alike locking handles and three-point catch.
 - 8. Appropriate conduit, wiring, and instrument openings shall be provided.
 - 9. Lifting eyebolts to allow simple, safe rigging and lifting of panel during installation.
- C. Wall Mounted Panels:
 - 1. Seams continuously welded and ground smooth.
 - 2. Rolled lip around all sides of enclosure door opening.
 - 3. Gasketed dust tight.
 - 4. Heavy GA hinge pins on doors.
 - a. Hinges rated for 1.5 times door plus instrument weight.
 - 5. Front full opening door.
 - 6. Manufacturer brackets for UL listed wall mounting.
- D. Internal Panel Wiring:
 - 1. Panel wire duct shall be installed between each row of components, and adjacent to each terminal strip.
 - a. 4" minimum depth shall be observed for all wire duct.
 - b. Wire duct shall be sized to observe fill limits and provide ample space for field wiring so that removable covers can snap-on at project completion.
 - c. Route wiring within the panel in wire-duct neatly tied and bundled with tie wraps.
 - d. Follow wire-duct manufacturer's recommended fill limits.
 - e. Wire-duct shall have removable snap-on covers and perforated walls for easy wire entrance.
 - f. Wire-duct shall be constructed of nonmetallic materials with rating in excess of the maximum voltage carried therein.
 - 2. Wiring shall be installed such that if wires are removed from one (1) device, source of power will not be disrupted to other devices.
 - 3. Splicing and tapping of wires permitted only at terminal blocks.
 - 4. Wire bunches to doors shall be secured at each end so that bending or twisting will be around longitudinal axis of wire.
 - a. Protect bend area with sleeve.
 - 5. Arrange wiring neatly, cut to proper length, with surplus wire removed.
 - a. Arrange wiring with sufficient clearance.
 - b. Provide abrasion protection for wire bundles that pass through openings or across edges of sheet metal.
 - 6. AC circuits shall be routed separate from analog signal cables and digital signal cables.
 - a. Separate by at least 2 IN, except at unavoidable crossover points and at device terminations.
 - 7. Provide at least 6 IN of separation between intrinsically safe devices and circuits and non-intrinsically safe devices and circuits.

8. Wiring to pilot devices or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without removing terminations.
 9. Conductors for AC and DC circuits shall be type MTW stranded tinned copper listed for operation with 600 V at 90 DegC.
 - a. Conductor size shall be as required for load and 16 AWG minimum.
 10. Analog signal cables shall be of 600 V insulation, stranded tinned copper, twisted-shielded pairs.
 - a. Conductor size: 18 AWG minimum.
 - b. Terminate shield drain conductors to ground only at one (1) end of the cable.
 11. High precision 250 ohm resistors with 0.25 percent accuracy shall be used where required.
 - a. Resistors located at terminal strips.
 - b. Resistors terminated using individual terminal blocks and with no other conductors.
 - c. Resistor leads shall be un-insulated and of sufficient length to allow test or calibration equipment (e.g., HART communicator, loop calibrator) to be properly attached to the circuit with clamped test leads.
 12. Analog signals for devices in separate enclosures shall not be wired in series.
 - a. Loop isolators shall be used where analog signals are transmitted between control enclosures.
 13. Wire and cable identification:
 - a. Wire and cables numbered and tagged at each termination.
 - b. Wire tags:
 - 1) Slip-on, heat shrinkable wire sleeves with legible, machine-printed markings.
 - 2) Adhesive, snap-on, or adhesive type labels are not acceptable.
 - c. Markings as identified in the Shop Drawings.
- E. Grounding Requirements:
1. Equipment grounding conductors shall be separated from incoming power conductors at the point of entry.
 2. Minimize grounding conductor length within the enclosure by locating the ground reference point as close as practical to the incoming power point of entry.
 3. Bond electrical racks, chassis and machine elements to a central ground bus.
 - a. Nonconductive materials, such as paint, shall be removed from the area where the equipment contacts the enclosure.
 4. Bond the enclosure to the ground bus.
 - a. It is imperative that good electrical connections are made at the point of contact between the ground bus and enclosure.
 5. Panel-mounted devices shall be bonded to the panel enclosure or the panel grounding system by means of locknuts or pressure mounting methods.
 6. Sub-panels and doors shall be bonded to ground.
- F. Termination Requirements:
1. Wiring to circuits external to the panel connected to interposing terminal blocks.
 2. Terminal blocks rigidly mounted on DIN rail mounting channels.
 3. Terminal strips located to provide adequate space for entrance and termination of the field conductors.
 4. One (1) side of each strip of terminal blocks reserved exclusively for the termination of field conductors.
 5. Terminal block markings:
 - a. Marking shall be the same as associated wire marking.
 - b. Legible, machine-printed markings.
 - c. Markings as identified in the shop drawings.
 6. Terminal block mechanical characteristics, and electrical characteristics shall be in accordance with NEMA ICS 4.
 7. Terminal blocks with continuous marking strips.
 - a. Each terminal block shall be identified with machine printed labels.

8. Terminals shall facilitate wire sizes as follows:
 - a. 120 Vac applications: Conductor size 12 AWG minimum.
 - b. Other: Conductor size 14 AWG minimum.
 9. Analog signal cable shield drain conductors shall be individually terminated.
 10. Install minimum of 20 percent spare terminals.
 11. Bladed, knife switch, isolating type terminal blocks where control voltages enter or leave the panel.
 12. Fused terminal blocks shall be used in the following circuits:
 - a. Control voltage is used to energize a solenoid valve or instrument.
 - b. DC power is connected to 2-wire, loop-powered instruments.
 13. Fused terminal blocks shall be provided with blown fuse indicators.
 14. When control circuits require more than one (1) field conductor connected to a single wiring point, a sufficient number of terminal points shall be connected internally to allow termination of only one (1) field conductor per terminal block.
 15. DIN rail mounting channels shall be installed along full length of the terminal strip areas to facilitate future expansion.
 16. Connections to devices with screw type terminals shall be made using spade-tongue, insulated, compression terminators.
- G. Component Mounting and Placement:
1. Components shall be installed per manufacturer instructions.
 2. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
 3. Front panel devices shall be mounted within a range of 40 to 70 IN above the finished floor, unless otherwise shown in the Contract Documents.
 4. PLC/RTU and I/O rack installation:
 - a. Located such that the LED indicators and switches are readily visible with the panel door open.
 - b. Located such that repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.
 5. Locate power supplies with sufficient spacing for circulation of air.
 6. Where components such as magnetic starters, contactors, relays, and other electromagnetic devices are installed within the same enclosure as the PLC/RTU system components, provide a barrier of at least 6 IN of separation between the “power area containing the electromagnetic devices” and the “control area”.
 7. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws.
 - a. Fastening devices shall not project through the outer surface of the panel enclosure.
 8. Excess mounting space of at least 20 percent for component types listed below to facilitate future expansion:
 - a. I/O card expansion and required terminals
 - b. Fuse holders.
 - c. Circuit breakers.
 - d. Control relays.
 - e. Time delay relays.
 - f. Intrinsically safe barriers and relays.
 9. Components installed on sub-panels shall be provided with a minimum spacing between component and wire duct of 1 IN.
 - a. Minimum of 2 IN separation between terminal strips and wire ducts.
 - b. Manufacturers recommended spacing shall take precedence.
- H. Power Distribution:
1. Main incoming power circuits shall be protected with a thermal magnetic circuit breaker.
 - a. Limit load to maximum of 80 percent of circuit breaker rating.

2. Component types listed below shall be individually fused so that they may be individually de-energized for maintenance:
 - a. PLC/RTU power supply modules.
 - b. Single-loop controllers.
 - c. Recorders.
 - d. Alarm annunciators.
 3. Equip each panel with necessary power supplies with ratings required for installed equipment and with minimum 25 percent spare capacity.
 4. Constant voltage transformers, balancing potentiometers, and rectifiers as necessary for specific instrument requirements.
- I. Internal Panel Lighting and Service Receptacles:
1. Panels less than or equal to 3 FT wide:
 - a. One (1) electrical GFCI duplex receptacle.
 - b. One (1) compact LED light fixture with motion or door activated switch(es)..
 2. Panels or panel faces greater than 4 FT wide:
 - a. One (1) duplex electrical GFCI receptacle per 6 FT of length.
 - b. Continuous LED lighting strip with motion or door activated switch(es)..
- J. Control Power Requirements:
1. Source power for control panels: Supply all transformers, protection, and power supplies needed to convert the supply voltage to the needed utilization voltage within each control panel.
 - a. All control panels shall be supplied with 120 VAC, Single phase, 60 Hz. power, unless otherwise indicated on the Drawings.
 - b. The control power shall be terminated within the process control panel at a main circuit breaker rated for the internal and external control loads.
 - 1) The hot conductor shall terminate on the line side of the main circuit breaker.
 - 2) The Neutral conductor shall terminate on a pass-through terminal block mounted adjacent to the main circuit breaker.
 - 3) The ground conductor shall terminate and on a grounding terminal block located at the bottom of the panel. The grounding terminal block will be used for the ground source for all grounding buses within the enclosure.
 - c. Surge protective devices shall be installed on the 120 VAC circuit and shall provide line and neutral protection.
 - 1) The line conductor shall be wired in parallel to the surge protective device on the load side of the main control power circuit breaker.
 - 2) The neutral conductor shall be wired in parallel to the surge protective device at the incoming neutral pass thru terminal block.
 - 3) The surge protective devices shall be grounded per the manufacturer's installation instructions. Grounding terminal blocks shall be used for ground connections.
 - d. The control panel shall be powered from a UPS backed source.
 - 1) The 120 VAC UPS line power shall be sourced from the surge protected 120 VAC process control panel circuit. The cord shall be wired to terminal blocks within the panel.
 - 2) UPS is to be mounted to the back panel within the enclosure.
 - 3) Outputs to include the following:
 - a) Battery Fail
 - b) Loss of Power
 - c) UPS Fault
 - e. The Process Control Panel 120V AC control power bus shall be cord and plug connected to the UPS outlet power. The cord shall be wired to terminal blocks within the panel.
 2. Where the supply voltage to the control panel is 480 or 240VAC as indicated on the electrical plans the control panel is to be furnished with a front mounted pad lockable integral disconnect.

3. The Process Control Panel control power shall be the source of power for all control instruments connected to the Process Control Panel, unless otherwise indicated on the Drawings.
 - a. All circuits being used to power field devices from the control panel 120 VAC bus are to be connected to a fused terminal block adequately sized for the device it serves.
 - b. Terminal blocks shall be provided for all internal and field installed equipment being powered from control panel 120 VAC power bus.
 - c. Provide a minimum of 30% spare terminal blocks for future 120 VAC powered equipment.
 4. The Process Control Panel shall be the source of power for all 24 VDC control instruments and devices connected to the Process Control Panel, unless otherwise indicated on the Drawings.
 - a. All circuits being used to power field devices from the control panel 24VDC bus are to be connected to a fused terminal block adequately sized for the device it serves.
 - b. Terminal blocks shall be provided for all internal and field installed equipment being powered from 24 VDC control power.
 - c. Provide a minimum of 30% spare terminal blocks for future 24 VDC powered equipment
- K. 24VDC Power Supply:
1. Provide (2) 24VDC power supplies for powering the control panel components and field instruments.
 2. Power supplies shall be configured as redundant, so that the failure of one will not affect the operation of the PLC and connected components.
 3. The power supplies shall have the “Power Supply OK” signals wired for indication.
 4. The two redundant power supplies shall be powered from the 120 VAC UPS backed control power circuit.
 5. The input shall be fuse protected per manufacturer recommendations.
 6. The outputs of each power supply shall be fuse protected.
 7. The negative or com of 24V DC supply shall be grounded.
- L. Miniature circuit breakers
1. Miniature circuit breakers shall be thermal-magnetic, current-limiting type. Breaker housing shall satisfy Insulation Group II/RAL 7035, shall have IP20 finger-safe design, shall be suitable for DIN rail mounting and shall include status indicator window and scratch- and solvent-resistant printing.
 - a. Miniature circuit breakers shall be Allen-Bradley Bulletin 1489-M or approved equal.
 - b. Miniature circuit breakers shall be rated for:
 - 1) Voltage – Max. 480Y/277 VAC, 48V DC (UL/CSA),
 - 2) Interrupting capacity – 10 kA (UL/CSA)
 2. Miniature circuit breakers shall support reversible line and load connections and shall have dual terminals that:
 - a. Connect up to 4 wires, or 2 wires and a bus bar.
 - b. Clamp conductors from both the top side and bottom side.
 3. Miniature circuit breakers shall be compatible with UL 508 Listed bus bars, auxiliary contacts, signal contacts, shunt trips and toggle-mount lockout attachments.
- M. Surge protector
1. Surge protectors shall use an MOV to clamp high voltage surges. The surge protective device shall provide visual indication, internal thermal disconnecting as well as remote monitoring of event and end of life failure. The surge protector shall be UL 1449 certified.
- N. Control Relays - Miniature
1. Miniature relays shall be, 2-pole, plug-in type with blade-style terminals and ON/OFF flag indicators. Miniature relays shall have an electrical schematic on the faceplate and a clear cover for visual inspection.
 - a. Miniature relays shall be Allen Bradley Bulletin 700-HK or approved equal.

- b. Shall be furnished with a plug-in, latching, finger safe, DIN rail mounted type socket with coil and contact separation.
 - c. Coils shall be rated for the voltage applied.
- O. Wire terminating component
- 1. Feed-through and fused terminal blocks for control wiring shall be molded type, screw compression clamp, DIN rail mounted with barriers rated not less than 300V, 25A, suitable for conductor ranging between No. 22 and No. 14.
 - a. Terminal blocks shall be Allen Bradley Bulletin 1492-J4 or approved equal.
 - b. Grounding terminal blocks shall provide DIN rail grounding clamp. Grounding terminal blocks shall be Allen Bradley 1492-JG4 or approved equal.
 - c. Fuse blocks shall be Allen Bradley 1492-WFB4 or approved equal
 - d. All fuse holders shall be populated with fuses and 100% spare fuses shall be supplied.
 - e. Fuses shall be appropriately sized for the application and power requirements of the load.
 - 2. Terminal block end anchors shall be used to secure all components onto the DIN rail at both ends of the DIN rail
- P. Industrial Network Switch:
- a. Provide DIN rail mount 8-port industrial network switch.
 - b. Furnish and install Ethernet Patch cables for connection between all Ethernet connected devices and instruments.
 - c. Connect Programmable Process Controller to switch via male RJ45 to male RJ45 manufactured and tested patch cord.
- Q. Environmental Controls:
- 1. Indoor panels located in a designated electrical room or control room:
 - a. Thermostat controlled cooling fans with exhaust louvers if required to maintain temperature inside panel(s) below the maximum operating temperature rating of the internal components.
 - b. Internal corrosion inhibitors.
 - 2. Indoor panels not located within a designated electrical room or control room:
 - a. Thermostat controlled heaters to maintain temperature approximately 10 DegF above ambient for condensation prevention inside the panels.
 - b. Automatically controlled, closed-loop heat exchangers or closed-loop air conditioners where required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel(s).
 - c. Internal corrosion inhibitors.
 - 3. Outdoor panels:
 - a. Outdoor temperature range of 0 DegF through 120 DegF.
 - b. Thermostat controlled heaters to maintain temperature approximately 10 DegF above ambient for condensation prevention inside the panels.
 - c. Outdoor temperature range of 0 DegF through 120 DegF.
 - d. Thermostat controlled closed-loop heat exchangers or closed-loop air conditioners if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel.
 - 4. Environmental control components:
 - a. Panel heaters:
 - 1) Thermostat controlled.
 - 2) Fan driven.
 - 3) Components mounted in an anodized aluminum housing.
 - 4) Designed for sub-panel mounting.
 - 5) Powered from 120 Vac and protected with a dedicated circuit breaker.
 - b. Cooling fans and exhaust packages:
 - 1) Cooling fan with louver or grill and replaceable filter.

- 2) Designed to be mounted within a panel cutout to provide positive airflow through the panel.
- 3) Cooling fan and exhaust louvers shall be designed and listed to maintain a NEMA 12 enclosure rating.
- 4) Fitted with replaceable, high-density foam or synthetic fiber.
- 5) Cooling fan controlled with a separately mounted thermostat with bi-metal sensor and adjustable dial for temperature setting.
- 6) Powered from 120 Vac and protected with a dedicated circuit breaker.
- c. Heat exchangers and air conditioners:
 - 1) Dual-loop design to isolate panel interior air from exterior air.
 - 2) Thermostat controlled.
 - 3) Operate from 120 Vac and protected with a dedicated circuit breaker.

2.4 MAINTENANCE MATERIALS

- A. Extra Materials:
 1. Quantity of 25 percent replacement lamps for each type installed (minimum of 12 of each type).
 2. Minimum 12 replacement filters for each type installed.
 3. 50% spare fuse quantities.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. Scope: Inspect and test entire panel assembly to verify readiness for shipment. Provide record drawings prior to shipment as specified.
- B. Location: Contractor's factory.
- C. Factory Tests:
 1. Tests shall be fully documented and signed by the Contractor's factory supervisor.
 2. The panel shop shall fully test the control panel for correct wiring consistent with contract documents.
 - a. Each I/O point shall be checked by measuring or connecting circuits at the field terminal blocks.
 3. Burn-in test: Panel(s) shall be fully energized for a minimum period of 24 HRS.
 4. A PLC Central Processing Unit (CPU) shall be obtained and connected to the panel(s) if necessary for testing purposes.
 5. Testing equipment (such as digital multi-meters, analog loop calibrators, and laptop computers with PLC programming software) shall be used as required for testing.
 6. The following functions shall be tested as a minimum:
 - a. Demonstrate functions of the panel(s) required by the Contract Documents.
 - b. Correctness of wiring from all panel field terminals to all I/O points and to all panel components.
 - c. Simulate and test each discrete signal at the field terminal strips.
 - d. Simulate and test each analog signal using loop calibrators.
 - e. Correct operation of communications between PLC system Central Processing Units (CPUs) and Remote I/O bases.
 - f. Correct operation of single-loop controllers (including digital communication to microprocessor based devices).
 - g. Correct operation of all digital communication devices.
 - h. Demonstrate online and offline diagnostic tests and procedures.
 - i. The Contractor shall notify the Engineer in writing a minimum of 15 calendar days prior to the Factory Tests.
 - 1) Engineer and Owner's Representative has the option to witness all required tests.
 7. Make following documentation available to the Engineer at test site during the tests:

- a. Contract Documents.
 - b. Factory Demonstration Testing procedures.
 - c. List of equipment to be testing including make, model, and serial number.
 - d. Shop Drawing submittal data for equipment being tested.
8. Deficiencies shall be corrected prior to shipment from the Contractor's factory.

3.2 INSTALLATION

- A. Anchor panels in a manner to prevent the enclosure from racking, which may cause the access doors to become misaligned.
- B. Obtain approved panel layouts prior to installation of conduits.
- C. Install products in accordance with manufacturer's instructions.
- D. Contractor shall provide redlined as-built drawings to engineer at project completion to be included in shop drawing record documents.

3.3 SCHEDULE

- A. Schedule:

TAG NUMBER	LOCATION
AB-LCP-01	AERATION BUILDING

END OF SECTION



DIVISION 41

**MATERIAL PROCESSING AND HANDLING
EQUIPMENT**



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SECTION 41 22 23
HOISTS, TROLLEYS, AND MONORAILS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Davit canes and bases.
- B. Related Sections include but are not necessarily limited to:
 - 1. Section 01 61 03 - Equipment - Basic Requirements.
 - 2. 43 25 13 - Pumping Equipment - Submersible Non-Clog.
 - 3. 46 41 00 - Mixers.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American Society of Mechanical Engineers (ASME):
 - a. B30.11, Safety Code for Underhung Cranes and Monorail Systems.
 - b. B30.16, Safety Code for Overhead Hoists.
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
- B. Comply with ASME B30.11 and ASME B30.16.

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. 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 factor) and the bearing life.
- D. Ultimate Load-Carrying Capacity: Live load, weights of all equipment and an allowance for impact.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01 61 03.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
 - 3. Fabrication and/or layout drawings.
 - a. Track layout including supports, splices, connections, switches, and end trucks.
 - 4. Test reports verifying strength of inserts and rail.
 - 5. Load test results.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:

- a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Davit Cranes:
 - a. Thern.
 - b. Vestil.

2.2 MANUFACTURED UNITS

- A. Davit Crane Bases:
 1. Bases for existing Anoxic Mixer 03 Crane (HST-307) and Anoxic Mixer 04 Crane (HST-310):
 - a. Existing cranes are Thern Series 5124 with wall-mount base and Thern 4WP2 Series worm gear power winch. New bases for existing cranes shall be rated for equivalent or greater load than the existing system.
 - 1) Provide Thern 5BW20 powder-coated wall mount or equivalent for each davit crane.
 - 2) Provide 316 stainless steel base anchor kit.
 - b. Mixer weight estimated to be 950 pounds. Contractor shall coordinate actual mixer load with approved mixer submittals.
 - 1) Lift shall have adequate capacity to lift equipment in all boom positions.
 - c. Lift below floor level: 3.5 feet.
 - d. Provide 20 feet of 1/4-inch diameter 304 stainless steel wire rope assembly.
- B. Davit Cranes:
 1. MLR Pump 05 Crane (HST-308), MLR Pump 06 Crane (HST-309), MLR Pump 07 Crane (HST-311), and MLR Pump 08 Crane (HST-312):
 - a. Davit cranes shall be Thern Captain 5FT25 or equivalent.
 - b. Manufacturer-standard powder-coat finish. See Section 09 96 00 - High Performance Industrial Coatings.
 - c. Up to 2,800-pound capacity.
 - d. Provide Thern Atlas II 3WG4 electric winch or equivalent for each davit crane.
 - 1) Power: 120V, 1 ph, 60 Hz.
 - 2) Maximum motor size: 1.5 Horsepower (HP).
 - 3) Include 8-foot power cord with grounded plug.
 - 4) NEMA 4 push button pendant on 6-foot cord.
 - 5) Meet NEC standards according to classifications as shown on Drawings.
 - e. Provide rotational lock for all davit cranes.
 - f. Provide powder-coated base plate integral to mast for each davit crane.
 - 1) Provide 316 stainless steel base anchor kit.
 - g. Pump weight estimated to be 950 pounds. Contractor shall coordinate actual pump load with approved pump submittals.
 - 1) Lift shall have adequate capacity to lift equipment in all boom positions.
 - h. Maximum Lift below floor level: 12.5 feet.
 - i. Maximum hook height: 150 inches or greater, measured above floor level.
 - j. Maximum hook reach: 120 inches or greater, measured from mast center line.
 - k. Provide 36 feet of 5/16-inch diameter 304 stainless steel wire rope assembly.

2.3 ACCESSORIES

- A. Provide weather protection for electric motor and winch spool.

- B. Electrification and Controls:
 - 1. Control Panels:
 - a. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.
 - 2. Provide electrical power to the motor-driven hoists and trolleys using one of the following methods as scheduled:
 - a. Festoon tagline 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.
 - b. Cable reel system:
 - 1) 360-degree swivel base.
 - 2) Full working length of cable plus 25%.
 - 3) Include all components needed for a complete and operable system.
 - 3. Controls:
 - a. Pendant pushbutton control stations with reversing type contactors for electric hoists.
 - b. Clearly mark function of each button.
 - c. Suspend station in a manner that will protect the electrical conductors against strain.
 - d. Control station: Operable from 115 V power supply.
 - e. Ground control station to hoist.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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 using 110% rated load.
- B. Employ and pay for services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by this Specification Section.
 - 2. Supervise pre-start-up adjustments, 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 8 hours at jobsite on operation and maintenance of the crane equipment.

3.3 SCHEDULE

A. Hoist, trolley, and monorail systems include but are not necessarily limited to the following:

TAG NUMBER	LOADING (LBS)	EQUIPMENT SERVED	HOOK REACH (IN)*	HOOK HEIGHT (IN)*	LIFT BELOW FLOOR LEVEL (FT)*	HP	OPERATING SPEED FPM**
HST-308	950	P-311	28 - 82	43 - 97	11.0	1.3	8 - 13
HST-309	950	P-312	28 - 82	43 - 97	11.0	1.3	8 - 13
HST-311	950	P-313	28 - 82	43 - 97	11.0	1.3	8 - 13
HST-312	950	P-314	28 - 82	43 - 97	11.0	1.3	8 - 13

* Distances listed are approximate as they will vary depending on hoist and trolley selection. Hook reach and height shall be adjustable based on boom position.

** Minimum operating speed corresponds to first layer of drum. Maximum operating speed corresponds to full drum.

END OF SECTION



DIVISION 43

**PROCESS GAS AND LIQUID HANDLING,
PURIFICATION, AND STORAGE EQUIPMENT**



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SECTION 43 05 21
COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Squirrel cage type, AC induction motors, up to 500 HP, for up to 4 poles (3600 or 1800 rpm nominal), or up to 250 HP for over 6 poles (1200 rpm or slower) shall be per NEMA MG1, Small or Medium.
 2. Special purpose motors with features or ratings which are not specified herein, are specified in the particular equipment specifications.

1.2 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 26 29 23 – Low Voltage Adjustable Frequency Drives

1.3 REFERENCES

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

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry- Premium-Efficiency, Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA MG 1	Motors and Generators
Department of Energy	Energy Policy and Conservation Act, Final Rules EERE-2010-BT-STD-0027-0117
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 1004	Electric Motors

1.4 DEFINITIONS

- A. Terminology used in this Section conforms with NEMA MG-1. Motors covered in this specification are those defined in NEMA MG1 as Small (Fractional) and Medium (Integral) AC induction motors.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Unit Responsibility: Where Unit Responsibility is specified in the driven equipment sections of these specifications, the motor supplier shall coordinate with the provider of the driven equipment to verify that the motor provided under this section is fully compatible with and meets the specified performance requirements for that equipment.

1.6 SUBMITTALS

- A. Action Submittals:
 - 1. Procedures:
 - a. Copy of this Section, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - b. Check-marks (✓) to denote full compliance with a paragraph as a whole. Underline deviations and denote by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance. Include a detailed, written justification for each deviation.
 - c. Failure to include a copy of the marked-up specification sections with justification(s) for any requested deviation will cause rejection of the entire submittal with no further consideration.
 - 2. Routine Factory test data for polyphase motors.
 - a. High-potential test.
 - 3. Factory test data, from required dynamometer tests, where specified.
 - 4. Vibration level when measured in accordance with NEMA MG 1, for all IEEE 841 motors, and where elsewhere specified.
 - 5. Motor heating curve, where specified.
 - 6. Motor mounting, outline, dimensions, and weight.
 - 7. Motor bearing and winding RTDs (resistance temperature detector), where specified.
 - 8. Motor winding thermostat or thermistor, where specified.
 - 9. Motor winding space heaters, where specified.
 - 10. Motor nameplate data.
 - 11. Inverter duty motors:
 - a. Motor winding voltage rating.
 - b. Variable or constant torque application.
 - c. Operating speed range.
 - 12. Conduit box dimensions, usable volume as defined in NEMA MG1 and NFPA 70, and conductor termination details.
- B. Informational Submittals:
 - 1. Submittal requirements for operation and maintenance manuals as per requirements of Division 1.

1.7 QUALITY ASSURANCE

- A. Factory Testing:
 - 1. All polyphase motors shall be factory tested in conformance with routine tests per NEMA MG1 and IEEE 112. Provide the following tests:
 - a. Measurement of winding resistance.
 - b. No-load readings of current and speed at normal voltage and frequency.
 - c. Current input at rated frequency with rotor at standstill.
 - d. High potential test.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Procedures shall be in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. The manufacturer's standard product may require modification to conform to specified requirements:
1. Baldor
 2. General Electric
 3. Siemens
 4. US Motors
 5. WEG
 6. Approved Equal

2.2 PERFORMANCE/DESIGN CRITERIA

- A. Service Conditions:
1. Temperature: -25-degree C to +40-degree C.
 2. Altitude: 0 to 3300 feet above sea level minimum.
 3. Derate motors for higher ambient temperature and for higher altitude with motor size based on brake-horsepower.
- B. Design Requirements:
1. Operation: Continuous.
 2. Compliance: Energy Policy Act of 1992 (EPAAct), Final Rule 2014.
 3. Tolerance: +/- 10-percent of rated voltage at rated frequency; +/- 5-percent of rated frequency at rated voltage.
 4. Standard design: NEMA Design B.
- C. Service Factor (percent of additional horsepower):
1. 1.15 for Sine-wave motors.
 2. Dual rating: 1.15 Sine-wave and 1.0 Inverter Duty for Inverter Duty motors.
- D. Motor Efficiency:
1. NEMA Premium™ efficiency electric motor, single-speed, polyphase, 1-500 horsepower, 3600-rpm 2-pole, 1800-rpm 4-pole, and 1200-rpm 6-pole (1-250 HP), squirrel cage induction motors, NEMA Design B, continuous rated. NEMA Standards Publication MG 1 2011, in Table 12-12.

Table 12-12 Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound)								
Open Motors								
HP	2 Pole		4 Pole		6 Pole		8 Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84	81.5	86.5	84.0	86.5	84.0	77.0	74.0
2	85.5	82.5	86.5	84.0	87.5	85.5	86.5	84.0
3	85.5	82.5	89.5	87.5	88.5	86.5	87.5	85.5
5	86.5	84.0	89.5	87.5	89.5	87.5	88.5	86.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5	89.5	87.5
10	89.5	87.5	91.7	90.2	91.7	90.2	90.2	88.5
15	90.2	88.5	93.0	91.7	91.7	90.2	90.2	88.5
20	91.0	89.5	93.0	91.7	92.4	91.0	91.0	89.5
25	91.7	90.2	93.6	92.4	93.0	91.7	91.0	89.5

Table 12-12 Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound)								
Enclosed Motors								
HP	2 Pole		4 Pole		6 Pole		8 Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5	78.5	75.5
2	85.5	82.5	86.5	84.0	88.5	86.5	84.0	81.5
3	86.5	84.0	89.5	87.5	89.5	87.5	85.5	82.5
5	88.5	86.5	89.5	87.5	89.5	87.5	86.5	84.0
7.5	89.5	87.5	91.7	90.2	91.0	89.5	86.5	84.0
10	90.2	88.5	91.7	90.2	91.0	89.5	89.5	87.5
15	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
20	91.0	89.5	93.0	91.7	91.7	90.2	90.2	88.5
25	91.7	90.2	93.6	92.4	93.0	91.7	90.2	88.5

2.3 MATERIALS

A. Motor frames:

1. TEFC motors shall be cast iron.
2. Aluminum frame motors are not permitted.

B. Stator windings:

1. Shall be copper with Class F minimum insulation not to exceed Class B temperature rise of 80-degree C at rated load and with Design B torque /current characteristics for all Medium (Integral) motors.
2. Small (fractional) motors shall be supplied with Class F insulation where available.

- C. Rotor material shall be aluminum or copper.
- D. Fans shall be non-sparking fan blades.
- E. Motor leads shall be non-hygroscopic.

2.4 MOTOR TYPES

- A. General Requirements for motors 1/2 horsepower through 500 horsepower:
 - 1. Three phase, squirrel cage, with copper windings.
 - 2. Rated for full voltage starting and continuous duty.
 - 3. Rating shall be:
 - a. 460/230 volts, three-phase, 60-Hertz, as shown on the contract drawings.
 - 4. General Purpose Type motors, which may also be called Type 1 per the project equipment specifications shall be:
 - a. Open Drip Proof Motors, shall be as defined per NEMA MG1, self-cooled by convection air.
 - b. Weather-Protected Type I Motors (WP-I), shall be as defined per NEMA MG1, similar to ODP construction with addition of screens to prevent entry of rain, snow, and particles, or objects into the motor. Suitable for clean indoor and protected outdoor installations.
 - c. Weather Protected Type II Motors (WP-II) shall be as defined per NEMA MG1, with maximum protection from entry of airborne particles, moisture and high velocity air. Suitable for unprotected outdoor installations.
 - 5. Severe Duty Type Motors, which may also be called Type 2 per the project equipment specifications, shall be in accordance with IEEE 841.
 - a. Totally Enclosed Fan-Cooled Motors (TEFC) shall be defined per NEMA MG1.
 - b. Enclosure: totally enclosed, fan cooled, with external fan blowing air to the motor frame cooling fins for cooling.
 - c. Applications: severe duty and most outdoor installations.
 - 6. Explosion Proof Type Motors, which may also be called Type 3 per the project equipment specifications.
 - a. Enclosures: UL listed explosion proof
 - b. Applications: hazardous locations including Class I and Class II (Division 1 and 2), and Class III classified areas.
- B. Motors Less Than 1/2 Horsepower:
 - 1. Type shall be:
 - a. Squirrel cage, capacitor start with Class F insulation and copper windings.
 - b. Fan motors rated 1/8 horsepower or less: split-phase or shaded-pole type.
 - 2. Rating shall be:
 - a. 115Volts, single phase, 60 Hz.
 - b. 208 Volts, single phase, 60 Hz.
 - c. 230 Volts, single phase, 60 Hz.

2.5 COMPONENTS

- A. Inverter-Fed Polyphase Motors per NEMA MG1 Part 31:
 - 1. Applications: variable torque or constant torque loads, for vertical or horizontal motors with variable frequency drive controllers (VFD).
 - 2. Features shall include:
 - a. Insulation design to meet 2000-Volt peak at a minimum of 0.1 micro-second rise time.
 - b. Built-in motor winding protection as specified.
 - c. Electrically insulated bearings or,
 - d. Provide Electro Static Technology's AEGIS Shaft Grounding Ring for Bearing Protection or equal. The shaft grounding ring shall be solidly bonded per manufacturer's recommendations.
- B. Thermal Protection:

1. Inverter duty motors:
 - a. Motors up to 50 horsepower:
 - 1) Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type.
 - 2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
- C. Motor Nameplates:
1. Materials: Engraved or stamped stainless steel.
 2. Features shall be as follows:
 - a. NEMA Standard MG 1 motor data.
 - b. Permanently fastened to the motor frame.
 - c. ABMA bearing identification number for motors meeting IEEE 841.
 - d. NEMA nominal efficiency for all motors.
 - e. NEMA nominal and minimum efficiency for motors meeting IEEE 841.
 - f. UL frame temperature limit code for explosion proof motors.
 - g. Space heater data.
 - h. Over Temperature Protection Type Number.
 - i. Temperature device rating and alarm and shutdown setpoint.
 - j. Provide motor nameplates for motors with space heaters located in Class I, Division 2, Groups C, and D areas in accordance with NEC 501.125(B).
- D. Conduit Boxes:
1. Provide oversized boxes, with split construction with threaded hubs and petroleum-resistant gaskets.
 2. Conduit boxes can be rotated in order to permit installation in any of four positions 90 degrees apart.
 3. Provide grounding lug located within the conduit box for ground connection.
 4. Provide separate conduit boxes for temperature devices and space heaters.
 5. Separate terminal box for any signal leads (RTD, thermistor, vibration transmitter, etc.).
 6. Provide with terminal block for conductor connections via Burndy YAV compression ring terminals on leads.
- E. Bearings:
1. Provide oil or grease lubricated ball bearings, angle contact roller bearings for axial thrust loads, and cylindrical bearings for radial-only loads.
 2. Rated for a minimum L-10 life of 50,000 hours for direct-connected loads.
 3. Cartridge type bearings will not be accepted.
 4. Fitted with lubricant fill and drain or relief fittings.
 5. Belt loads not to exceed forces calculated from NEMA MG 1 Table 14-1 and 14-1A.
- F. Bearing lubrication shall be either grease or oil as per the requirements in either 1 or 2:
1. Grease lubricated bearings:
 - a. Shall be for electric motor use only.
 - b. Grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
 - c. Provide grease fittings, similar to Alemite™ type (or equivalent).
 - d. Shielded bearings with regreasable provisions are permissible.
 2. Provide oil lubricated bearings with externally visible sight glass to view oil level.
- G. Lifting Eyes:
1. Provide lifting eyes with a safety factor of 5.
 2. Provide one lifting eye for motors more than 50 pounds.
 3. Provide two lifting eyes for motors over 150 pounds.
- H. Winding Space Heaters when specified or shown:
1. Provide winding space heaters to prevent condensation.
 2. Rating: 120 volts, single phase, 60 Hertz.
 3. Motor nameplate to show space heater rating in watts and volts.

4. Provide terminal block in motor conduit box for heater leads termination.

2.6 FINISHES

- A. Paint Finish:
 1. Provide standard manufacturer paint finish.
 2. Provide motors with semi-gloss finish, scratch and heat resistance electric motor paint.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Delivery Inspection:
 1. Inspect driven equipment-motor assembly and components immediately upon delivery and unloading at the job site for damages.
 2. Take photos of damage(s) if any, to substantiate the delivery inspection report.

3.2 INSTALLATION

- A. Grounding of Motors:
 1. Connect the motor feeder ground cable (green) to the grounding lug terminal in the conduit terminal box.
- B. Supplemental Grounding of Motors: Provide for motors fed from VFDs, all motors above 100 horsepower, and all motors in classified areas, where feasible.
 1. Bond the motor frame to the grounding grid/electrode system to provide supplemental grounding.
- C. Field Coating of Motors:
 1. Refer to the driven equipment specification section and Section 09 96 00 for coating requirements.

3.3 FIELD QUALITY CONTROL

- A. Field Testing:
 1. Measure winding insulation resistance of motors to no less than 10-megohm with a 1000-Vac megohmmeter.
 2. Test motors for proper rotation prior to connection to the driven equipment.
- B. Field Inspection:
 1. Compare equipment nameplate data with drawings and specifications.
 2. Inspect physical and mechanical condition.
 3. Inspect anchorage, alignment, and grounding.
 4. Verify the installation of breather/drain fittings as specified herein.
 5. Check for proper connections of space heaters, winding and RTDs and or thermostats.
 6. Visually check for correct phase and ground connections:
- C. Manufacturer Services: Provide where specified or shown on the drawings.
 1. Provide services to the driven equipment manufacturer for the inspection and certification of the installation of the motor driven equipment.
 2. Provide assistance in the startup and operational testing of the motor driven equipment.

3.4 SYSTEM START UP

- A. Commissioning Test: Provide where specified or shown on the drawings.
 1. Provide assistance during the commissioning test of the motor driven equipment.

3.5 CLOSEOUT ACTIVITIES

- A. Operation and Maintenance:
 1. Provide the operation and maintenance manual of the motor(s). Include testing result information in the O&M manual.

END OF SECTION

SECTION 43 21 00
PUMPING EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pumping equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 09 96 00 - High Performance Industrial Coatings.
 - 2. Section 01 61 03 - Equipment - Basic Requirements.
 - 3. Section 03 15 19 – Anchorage to Concrete
 - 4. Section 43 25 13 - Pumping Equipment - Submersible Non-Clog.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ANSI/Hydraulic Institute (ANSI/HI):
 - a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
 - b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
 - c. 9.6.6, Rotodynamic Pumps for Pump Piping.
 - d. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
 - e. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
- B. Coordinate all mechanical seal systems specified to ensure pump and seal compatibility.
- C. Pump/motor and VFD coordination: See Specification Section 01 61 03.

1.3 DEFINITIONS

- A. The abbreviations used in this section are defined as follows:
 - 1. AOR: Allowable Operating Range.
 - 2. BEP: Best Efficiency Point.
 - 3. IPS: Iron Pipe Size.
 - 4. NPSH3: Net Positive Suction Head for 3% head loss.
 - 5. POR: Preferred Operating Range.
 - 6. TDH: Total Dynamic Head.
 - 7. TEFC: Totally Enclosed Fan Cooled.
 - 8. VFD: Variable Frequency Drive.
- B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 61 03.
 - 2. Product technical data including:
 - a. Performance data and curves with flow (GPM), head (FT), horsepower, hydraulic efficiency, rotating speed (RPM), AOR, BEP, POR, NPSH3 requirements, minimum bowl submergence requirements for vertical mixed flow, axial and turbine pumps.
 - b. Pump accessory data.
 - c. Bearing supports, shafting details and lubrication provisions.
 - 1) Bearing life calculations.
 - 2) Critical speed calculations.

- d. Solids passage information.
- e. Anchor design information required by Section 03 15 19.
- 3. Certifications:
 - a. Certified pump performance curves as described in the SOURCE QUALITY CONTROL Article.
 - b. Verification of Primary and Secondary conditions in POR and AOR.
- 4. Test reports:
 - a. Factory hydrostatic test.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. Certifications:
 - a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Pumps:
 - a. See individual pump Specification Sections.
 - 2. Mechanical seals:
 - a. Chesterton.
 - b. John Crane.
 - c. Garlock.
 - d. Or as noted in the individual pump Specification Sections.
 - 3. Seal water station:
 - a. Chesterton.
 - b. John Crane.
 - c. AESSEAL.

2.2 CENTRIFUGAL PUMP DESIGN

- A. Provide units with increasing head characteristics from the end run out portion of the curve to:
 - 1. Shut-off condition.

2.3 ACCESSORIES

- A. See Specification Section 01 61 03.
- B. Each Unit:
 - 1. Lifting eye bolts or lugs.
 - 2. Plugged gage cock connection at suction and discharge nozzles.
 - 3. Tapped and plugged openings for casing and bearing housing vents and drains.
 - 4. Fittings for properly adding flushing lubricant.
 - 5. Pressure relief fittings for grease lubrication.
- C. Packing Seal:
 - 1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
 - 2. Minimum of five rings graphite impregnated synthetic packing.
 - 3. Provide minimum 1/4 inches diameter supply tap and 1/2 inches diameter minimum drain tap.
 - 4. Provide split Teflon or bronze water seal ring.

5. Adjustable split follower cast iron or bronze gland.
- D. Mechanical Seals:
1. Provide as specified in the narrow-scope pump sections.
 2. Provide water lubrication - cooling.
 3. 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.
- E. Seal Water Station:
1. Provide one unit per pump with manual shut-off valve on all pumps with seals.
 2. Features:
 - a. Pressure regulating.
 - b. Flow regulating.
 - c. Cleanable flow tube(s) while in service.
 - d. Hose barb connection.
 - e. Liquid filled pressure gage.
 3. Materials of construction:
 - a. Flowmeter tubes: Polysulfone.
 - b. Unit body: Polyoxymethylene.
 - c. Pressure gage: 316 stainless steel case and wetted parts.
 - d. Pressure regulating valve: 316 stainless steel.
 - e. Flow regulating valve: 316 stainless steel.
 - f. Tube fittings: 316 stainless steel.
 - g. Mounting brackets: 316 stainless steel.
 4. Service:
 - a. Temperatures up to 150 degrees F.
 - b. Pressure up to 140 psiG.
 5. Connection:
 - a. Hose barb threaded to pump.
 - b. Hose barb to seal water unit.
 - c. Reinforced polyurethane hose:
 - 1) Minimum size: 3/8 inches ID.
 - 2) Minimum pressure rating:
 - a) At 180 degrees F: 115 psi.
 - b) At 73 degrees F: 200 psi.
 - 3) Minimum wall thickness: 1/8 inches.
 - d. Non-potable water to shut-off valve: See Section 40 05 00 with isolation ball valve.
 6. Mounting:
 - a. To pump or pipe flange with stainless steel bracket.
 - b. Maximum distance from non-potable water to shut-off ball valve to seal water station and seal water station to pump seal, 2 feet each direction.

2.4 FABRICATION

- A. Pump Support:
1. Design base to support weight of drive, shafting and pump.
 2. Comply with HI vibration limitations.
 3. Mount horizontal pump, motor and coupling on single piece drip lip type machine base.
 4. Mount vertical pumps on single piece pedestal machine base.
 5. Mount vertical turbine/propeller/can pumps on a rigid machined base plate attached to the discharge elbow. Base plate to be bolted to the pump can or an independent rigid machined sole plate grouted to the concrete substructure with anchor rods and leveled with jackscrews.
 6. Fabricate to withstand all operating loads transmitted from the pump and drive.

7. On vertically configured end suction centrifugal pumps when supplied with a fabricated steel mounting frame and suction elbow, the suction elbow shall be a long radius reducing elbow with greater than 50% area reduction to comply with Table 9.6.6.3.2 of ANSI/HI 9.6.6 standard for straight pipe lengths.

2.5 SOURCE QUALITY CONTROL

- A. Verification primary design condition in POR.
- B. Verification secondary design condition in AOR.
- C. Factory hydrostatic test all pumps at 150% of shut-off head for a minimum of five minutes.
- D. If specifically required in the individual pump specification sections, provide factory tests:
 1. All units:
 - a. Conduct tests in accordance with HI.
 - 1) Shut-off head and design condition: Positive unilateral performance tolerance meeting Grade 1U per ANSI/HI 14.6 for Rotodynamic Pumps.
 - 2) Shut-off head and design conditions: Positive unilateral performance tolerances meeting Grade 1U per ANSI/HI 11.6 for Rotodynamic Submersible Pumps.
 2. All pumps:
 - 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.
- E. Statically and dynamically balance each pump per ANSI/HI standards.
 1. If specifically required in the individual pump specification sections or in Specification Section 01 61 03, field vibration test pumps:
 - a. To meet requirements of ANSI/HI 9.6.4 for Rotodynamic Pumps at any point on the pumps and motor.
- F. To meet requirements of ANSI/HI 11.6 for Submersible Pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 01 61 03.
- 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.
 - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - b. Realign as necessary, install flange bolts and make equipment connection.
 8. Field paint units as required by manufacturer.
 9. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.

C. Submersible Units:

1. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
 - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - b. Realign as necessary, install flange bolts and make equipment connection.
2. Field paint units as required by manufacturer.
3. Provide discharge pressure gage visible from grade or operating floor.

3.2 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by this Specification Section.
 2. Supervise pre-start adjustments and installation checks.
 3. Conduct initial start-up of equipment and perform operational checks.
 4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 75 00 on operation and maintenance of each of following pumping equipment:
 - a. Section 43 25 13 - Pumping Equipment - Submersible Non-Clog, 8 hours.

END OF SECTION

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SECTION 43 25 13
PUMPING EQUIPMENT SUBMERSIBLE NON-CLOG

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submersible sewage pumps in a wet pit application for pumping of mixed liquor.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 09 96 00 - High Performance Industrial Coatings.
 - 2. Section 26 05 00 - Electrical - Basic Requirements.
 - 3. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 - 4. Section 26 24 19 - Low-Voltage Motor Control.
 - 5. Section 26 29 23 - Owner-Furnished Low-Voltage Adjustable Frequency Drives.
 - 6. Section 43 05 21 - Common Motor Requirements.
 - 7. Section 43 21 00 - Pumping Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American National Standards Institute (ANSI).
 - 3. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - 4. FM Global (FM).
 - 5. Hydraulic Institute (HI):
 - a. Standards for Centrifugal, Rotary and Reciprocating Pumps.
 - 6. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 7. National Fire Protection Agency (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 500, Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2.
 - 8. Underwriters Laboratories, Inc. (UL).
 - a. 62, Flexible Cord and Fixture Wire.

1.3 SYSTEM DESCRIPTION

- A. The Mixed Liquor Return (MLR) Pumps are submersible pumps located in Zone 3 of each aeration basin. These pumps recycle mixed liquor from the end of the aeration basin trains back to the front as part of the biological process modifications. Two (2) pumps will be installed in each aeration basin train (Aeration Basin 03 and Aeration Basin 04), for a total of four (4) installed pumps.
- B. The MLR Pumps will be powered by Owner-Furnished 12-HP variable frequency drives.
- C. The MLR Pumps will service mixed liquor with a total suspended solids concentration of up to 5,000 milligrams per liter (mg/L).
- D. Provide single source coordination responsibility through the pump manufacturer for the entire system including but not limited to the following:
 - 1. Pumps.
 - 2. Motors.
 - 3.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Requirements in Specification Section 01 61 03 - Equipment - Basic Requirements.
 - 2. Requirements in Specification Section 43 21 00 - Pumping Equipment - Basic Requirements.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 78 23 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.
- C. Project Information:
 - 1. Executed Manufacturer's Installation Certification Form.
- D. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

1.5 SHIPPING

- A. Per Section 01 61 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Flygt.
 - 2. Ebara.
 - 3. Sulzer – ABS.
 - 4. KSB Pumps.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. MLR Pump 05 (P-311), MLR Pump 06 (P-312), MLR Pump 07 (P-313), MLR Pump 08 (P-314):
 - 1. Shutoff Head (range): 35 feet to 40 feet.
 - 2. Design Condition:
 - a. Flow: 1,200 GPM.
 - b. Head: 14.9 feet.
 - c. Minimum Hydraulic Efficiency: 59%.
 - d. Flow Relative to BEP (PCT range): 80% to 120%.
 - e. Maximum NPSH3: 14 feet.
 - 3. Runout Condition:
 - a. Minimum Flow: 1,360 GPM.
 - b. Maximum Head: 8.25 feet.
 - c. Minimum Hydraulic Efficiency: 54%.
 - d. Flow Relative to BEP (PCT): <150%.
 - e. Maximum NPSH3: 15 feet.
 - 4. Secondary Condition (33 Hz operation):
 - a. Maximum Flow: 600 GPM.
 - b. Minimum Head: 3.2 feet.
 - c. Minimum Hydraulic Efficiency: 60%.
 - d. Flow Relative to BEP (PCT range): 80 to 120% at 33 Hz.
 - e. Maximum NPSH3: 5 feet.
 - 5. Maximum Suction Diameter: 6 inches.
 - 6. Minimum Discharge Diameter: 6 inches.
 - 7. Pump Rotation: Per Drawings.

- a. Motor requirements:
 - 1) Maximum Operating Speed: 1,200 RPM.
 - 2) Minimum Operating Speed: 750 RPM.
 - 3) Service factor: 1.14.
 - 4) Minimum motor efficiency at the Design Condition: 84%.
 - 5) Minimum power factor: 65%.
 - 6) Maximum nameplate horsepower: 12 HP.
- b. Drive type: Variable speed.
- c. Ambient conditions:
 - 1) Wastewater maximum temperature: 20 DEGC.
 - 2) Air maximum temperature: 105 DEGF.

2.3 MATERIALS

- A. MLR Pump 05 (P-311), MLR Pump 06 (P-312), MLR Pump 07 (P-313), MLR Pump 08 (P-314):
 - 1. Pump case: Cast iron, ASTM A48, Class 35.
 - 2. Motor housing: Cast iron, ASTM A48, Class 25 or Class 30.
 - 3. Impeller: Cast iron, ASTM A48, Class 35.
 - 4. Shaft: Stainless Steel, Series 300 or 400.
 - 5. Wear Surfaces: Cast iron, ASTM A48, Class 35..
 - 6. O-rings: Nitrile (Buna-N) or fluorocarbon (Viton).
 - 7. Fasteners: Stainless steel.
 - 8. Double mechanical seal:
 - a. Pump-Side Mechanical Seal: Silicon Carbide both faces.
 - b. Bearing-Side Mechanical Seal: Silicon carbide both faces, or carbon and silicon carbide.
 - c. Seal metal parts: Stainless steel.
- B. Wet Pit Application:
 - 1. Guide rails: Type 316 Stainless steel.
 - 2. Lifting chains and cables: Type 316 Stainless steel.
 - 3. Base elbow: Cast iron, ASTM A48, Class 35.

2.4 COMPONENTS

- A. General:
 - 1. Provide pumps capable of handling mixed liquor.
 - 2. Where watertight sealing is required, machine and fit mating surfaces with O-rings.
 - 3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.
- B. Impeller:
 - 1. Provide enclosed solids-handling type dynamically balanced impeller in accordance with HI standards.
 - 2. Provide impeller and volute wear rings as necessary to assure efficient sealing between volute and impeller.
- C. Shaft:
 - 1. Design shaft for a maximum deflection of 0.004 inches at the stuffing box as calculated at the design condition.
- D. Mechanical Seal:
 - 1. Seal shaft with double mechanical seal running in an oil filled chamber.
 - 2. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
 - 3. Hold interface in contact by its own spring system.
- E. Bearings:

1. Support shaft on upper and lower permanently lubricated bearings with a minimum ABMA L-10 life of 100,000 hours.
- F. Motors:
1. Provide pump with FM, UL, or CSA listed motor approved for Class 1 Division 1 service.
 2. Provide induction type motor with a squirrel cage rotor, of totally submersible design without loss of watertight integrity to a depth of at least 65 feet, constructed with epoxy or poly-seal encapsulated windings, air-filled or dielectric oil filled, with Class H insulation rated for 180 degrees C and rated for continuous duty operation.
 3. Motor shall be 3 PH, 60 cycle, 480 V.
 4. Motor shall be capable of running continuously in an unsubmerged condition while pumping under load without damage to motor or seal.
 5. The motor horsepower provided shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through runout.
 6. The motor shall be designed and assembled by the same manufacturer as the pump.
 7. The motor shall be equipped with a closed loop cooling system where the cooling medium is circulated through the pump motor cooling jacket. The pumped fluid shall not be circulated through the cooling jacket. An impeller in the lower motor coolant reservoir will circulate coolant around the motor housing. The cooling system shall provide sufficient cooling for continuous operation whether the pump is submerged in the pumped media or surrounded by air in liquid or ambient temperatures of up to 40 degrees C.
 8. Cooling system will provide sufficient cooling for the entire range of pump operating speeds.
- G. Power and Control Cables:
1. Provide power and control cables which are listed per NEC requirements and approved for the installation types indicated on the drawings. As a minimum the cable shall be suitable for installation in conduit and for submersible applications.
 2. Size cables in accordance with applicable NFPA 70 specifications.
 3. Provide 50 feet power cable and control cable.
 4. Provide each cable with a strain relief, cord grip, and explosion proof seal installed in accordance with NFPA 70, Article 500.
 5. Minimum acceptable cable type: "SO-Water Resistant" per UL 62.
- H. Temperature Monitor:
1. Furnish each phase of the motor with thermal switches embedded in the motor windings.
 2. Should high temperature be sensed in the windings, the thermal switch will open, shut the pump down, and sound an alarm. Should any one of the thermal switches detect high temperature, it will automatically reset once the stator temperature returns to normal.
 3. Set temperature of the temperature monitors not higher than 90% of insulation temperature rating.
- I. Leak Detection:
1. Provide sensors inside the terminal board and the stator chamber to detect water intrusion
 2. If water is detected inside the terminal board or the stator chamber, a switch will stop the pump and sound an alarm.
- J. Coatings:
1. Apply two-component oxirane ester or polyamidoamine epoxy system to the exterior of the pump casing and motor housing as specified in Specification Section 09 96 00.
- K. Wet Pit Applications:
1. Provide sliding guide bracket integral to pump unit which properly aligns the pump discharge with the discharge connection elbow for watertight seal during pumping.
 2. Guide the entire weight of the pumping unit to the base discharge elbow by guide rail(s).
 3. The guide rail(s) shall not support any portion of the weight of the pump.
 4. Provide chains or cable of sufficient strength to lift pumps from sump.

5. Furnish guiding rail assembly and the discharge flange assembly of nonsparking components.
6. Design pump to allow for removal without entering the wet well and without removal of bolts, nuts or other fastenings.
7. Provide pump unit connecting to discharge connection with a simple downward motion without rotation. The entire weight of the pumping unit shall wedge tightly against the discharge elbow flange forming a seal without the use of bolts, gaskets, or O-rings.
8. Provide necessary sliding guide bracket and discharge connection which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.
9. No portion of the pump shall bear directly on the floor.

2.5 ACCESSORIES

- A. See Specification Section 43 21 00 - Pumping Equipment: Basic Requirements.
- B. Controls:
 1. See Electrical and Instrument and Controls Designs for controls requirements.
- C. Local Control Stations:
 1. Provide local control stations for each pump.
 2. Local control stations at a minimum shall include:
 - a. Running light (green).
 - b. Fault light (amber).
 - c. Hand-Off-Auto (HOA) switch.
 - d. Speed control (SC) switch.
 - e. Push-button emergency stop (E-Stop) with red button.

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 this Specification Section.
 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.
 4. Run pump submerged for 30 minutes.
 5. After operational test #4, perform insulation test (#2) again.
- B. Factory test of head (FT) versus flow (GPM) for one pump of each service category as specified in Section 43 21 00 - Pumping Equipment - Basic Requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 43 21 00.
- B. For wet pit pumps, permanently install discharge connection elbow along with discharge piping.
- C. Seal pump cable end with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

3.2 FIELD QUALITY CONTROL

- A. See Specification Section 43 21 00.

3.3 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

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DIVISION 46

WATER AND WASTEWATER EQUIPMENT



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SECTION 46 41 00
MIXERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floating aeration basin mixers.
- B. Related Specification Sections include but are not necessarily limited to:

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American Gear Manufacturers Association (AGMA):
 - a. 390.03a, Gear Handbook - Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears.
 - 3. American Iron and Steel Institute (AISI).
 - 4. National Fire Protection Agency (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 500, Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. General:
 - 1) Materials.
 - 2) Parts.
 - 3) Accessories.
 - 4) Assembly.
 - 5) Installation.
 - c. Mixers:
 - 1) Manufacturer.
 - 2) Type and model.
 - 3) Design rotative speeds.
 - 4) Bearing types and life calculations.
 - 5) Dimensions and net weight.
 - 6) Pumping capacity and water horsepower or delivered power.
 - 7) Materials of construction.
 - 8) Mounting requirements and design forces: Torque and bending load.
 - 9) Disassembly procedure for impeller access.
 - 10) Calculations supporting all shaft and impeller design criteria (stress and critical speed).
 - d. Drive units:
 - 1) Manufacturer.
 - 2) Type and model.
 - 3) Rated size.
 - 4) Temp rating and service factor.
 - 5) Dimensions and weight.
 - 6) Lubrication systems.
 - e. Verification of bearing life.

- f. Manufacturer's installation instructions.
 - 2. Fabrication and/or layout drawings.
 - 3. Certifications.
 - 4. Test reports.
- B. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Aqua-Aerobic Systems, Inc SS Endura Series AquaDDM.
 - 2. Evoqua Water Technologies Aqua-Lator Direct Drive Mixer.

2.2 MATERIALS

- A. Floating aeration basin mixers:
- 1. Mixer housings: 304 Stainless steel.
 - 2. Impeller shaft: Stainless steel, 17-4 PH.
 - 3. Impeller: 316 Stainless steel.
 - 4. Mooring: 304 Stainless steel.
 - 5. Floats: 304 Stainless steel.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Floating aeration basin mixers (MXR-303 & MXR-304):
- 1. Aeration Basin Zone Dimensions.
 - a. Length: 39.25 feet.
 - b. Width: 46 feet.
 - c. Sidewater Depth: 12 feet.
 - 2. Design Maximum Mixed Liquor Suspended Solids: 5,000 mg/L.
 - 3. Number of units: 2.
 - 4. Number of impellers per mixer: One.
 - 5. Impeller diameter: 11.5 inches.
 - 6. Motor HP: 7-1/2 HP maximum.
 - 7. Rotating speed: 1,200 rpm.
 - 8. Drive type: Single speed.
 - 9. Mixer rotation viewed from overhead:
 - a. ABM-5203: CW.
- B. Bearing life at full nameplate horsepower: Minimum ABMA L-10 of 100,000 hours.

2.4 FABRICATION AND MANUFACTURE

- A. Floating aeration basin mixers:
- 1. Impeller:
 - a. Axial flow basic design.
 - b. Dynamically and hydraulically stable.
 - c. Blades bolted to hub, impeller bolted to impeller shaft.
 - d. Maximum stress on impeller component not to exceed 11,000 psi under maximum operation load.
 - e. Use of stabilizing rings or fins will not influence stress limitations specified.
 - 2. Speed reducer:
 - a. Designed and rated per AGMA standards.

- b. Type:
 - 1) Right angle gear drive:
 - a) Aeration basin mixers: Low head room design.
 - 2) Quill-type drive shaft, independent bearing support with flexible coupling connected to output shaft above the reducer.
 - 3) Separate agitator shaft bearings located above and below the main drive bearings.
 - 4) Combination helical, spiral bevel, and pinion drive gears.
 - 5) Totally enclosed.
 - 6) Worm gears not acceptable.
 - c. Service factor: 1.15 of nameplate on motor.
 - d. Gearing: AGMA #10 or better (AGMA 390.03a).
 - e. Bearing design:
 - 1) Antifriction type, ball or roller, oil or grease lubricated.
 - 2) All shaft bearings located outside of tankage.
 - f. Lifting lugs.
 - g. Lubrication:
 - 1) Oil or grease lubricated.
 - 2) Positive lubrication of all gears and bearings.
 - 3) Maintain recommended thermal rating of reducer; cooling system, and oil pumps if required.
 - 4) Dipstick oil level indicators.
 - 5) Adequate separation between oil and grease lubricated parts.
 - 6) Oil breather located above possible oil foam level.
 - h. Lubricating provisions:
 - 1) Oil drain:
 - a) Minimum 6 inches above top of bridge.
 - b) Piped discharge to portable waste oil container.
 - c) Supply a minimum of two waste oil containers.
 - 2) Grease fittings protected by removable neoprene cover and easily accessible.
 - 3) Greased bearings with seal to retain grease.
 - i. Reducer output shaft and impeller shaft:
 - 1) Oversized for direct, rigid coupling to impeller shaft below reducer.
 - 2) Maximum indicated runout not to exceed 1/8 inches for every 10 feet of overhang, as measured when turning by hand.
 - 3) Maximum stress: 8,000 psi at maximum load.
 - 4) Independent bearing support between output shaft and hollow quill drive shaft to isolate speed reducer from shock loads, impeller bending loads, and the weight of impeller shaft.
 - 5) Torsionally resilient, flexible coupling between hollow quill drive shaft and output shaft above the reducer.
3. Coupling:
 - a. Rigid flange on output shaft located for ease of access.
 - b. Output coupling designed to transmit 200% of full torque and 150% of axial load.
 - c. Output coupling located outside tankage.
 4. Motor:
 - a. 460 V, 3 PH, 60 Hz.
 - b. TEFC, 1.15 square feet.
 - c. Energy-efficient type.
 - d. Shovel base mounted.
 - e. Aeration basin mixers: 1,200 rpm.
 - f. Class F non-hygroscopic insulation.
 - g. Provide mixer with motor approved for Class 1 Division 2 service.
 5. Floats and Platform:
 - a. 14-gauge 304 stainless steel skin filled with closed cell polyurethane.
 - b. Minimum Reserve Buoyancy: 775 lbs.

- c. 6 mooring points spaced for 4 points around the outer circumference.
- 6. Mooring:
 - a. 180 feet of 7 x 19 x 3/16" high flex 304 stainless steel mooring cable per mixer.
 - 1) Provide one (1) full spare set of mooring cables.
 - b. 12 cable clips and 6 thimbles to moor equipment using a 4-point connection.
- 7. Electrical Service Cable
 - a. Set(s) of 50-foot electrical cable and appurtenances for 460 V, 7-1/2 HP operation.
 - b. Includes electrical cable, kellums, and spiral wraps.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify that structures, pipes, and equipment are compatible.
- B. Install per manufacturer's recommendation.
- C. Make adjustments required to place system in proper operating condition.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer shall check and approve mixer installation before field operation, verify conformance with Contract Documents, and test and operate mixers in the presence of Engineer and/or Owner.
- B. Demonstrate the power demand of each drive motor does not exceed nameplate horsepower or nameplate full load ampere rating.
- C. Demonstrate each mixer is capable of operating without undue noise or vibration. Adjust, repair, or replace defective equipment.
- D. Furnish necessary equipment required for testing mixers and properly calibrating instruments.
- E. Provide services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by this Specification Section.
 - 2. Supervise pre-start adjustments and installation checks.
 - 3. Conduct initial start-up of equipment and perform operational checks.
 - 4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 75 00 on operation and maintenance of each of following pumping equipment:
 - a. Section 46 41 00 - Mixers, 8 hours

END OF SECTION

SECTION 46 51 00
AERATION EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Replacement of existing ceramic diffusers and blank diffusers with new diffuser holders and elements.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 01 61 03 - Equipment - Basic Requirements.
 - 2. Section 46 51 33 - Flexible Membrane Disc Diffusers.
- C. Coordination:
- D. Specific Requirements:
 - 1. For aeration system equipment, assemble in factory to ensure proper fit.
 - a. Mark parts with erection marks, disassemble for shipment.
 - 2. Employ and pay for the services of authorized manufacturer's factory or service representative to:
 - a. Inspect equipment installed by this Specification Section.
 - b. Supervise adjustments, perform modifications as necessary.
 - c. Conduct start-up of equipment.
 - d. Supervise specified performance tests and operational test.
 - 1) Provide personnel needed to conduct and set up tests, perform testing and calculations.
 - e. Write complete field report covering but not necessarily limited to results of installation check, startup, testing, and adjustments.
 - f. Instruct Owner's personnel for a minimum period on jobsite on operation of following:
 - 1) As indicated in Section 46 51 33 - Flexible Membrane Disc Diffuser.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME).
 - 2. Compressed Gas Association (CGA).

1.3 DEFINITIONS

- A. SCFM (Standard Cubic Feet Per Minute): Flow of air or gas at standard conditions defined by ASME and CGA with quantity expressed as volume in cubic feet per minute at 68 degrees F 14.70 pounds per square inch absolute pressure and 36% relative humidity.
- B. ICFM (Inlet Volume in Cubic Feet Per Minute): Volume of air or gas in cubic feet per minute (cfm) actually entering the blower device in reference.
- C. References: Refer to Volume 2 Appendix A for detailed requirements of owner-furnished twisted tri-lobe ("hybrid") blowers included in the Project.

1.4 SUBMITTALS

- A. Provide six copies of written report covering "Specifier Requirements" as previously outlined.
 - 1. Ensure reports are certified by manufacturer of equipment.

1.5 PERFORMANCE TESTING REQUIREMENTS

- A. Comply with requirements of Specification Section 01 61 03.

B. General:

1. Perform dissolved oxygen concentration measurements by direct reading instruments which have been standardized against a laboratory determination of dissolved oxygen as described in latest edition of "Standard Methods for Examination of Water and Waste Water" with appropriate modification for interfering substances.
 - a. Multiple probes will be required as detailed under Paragraph A and appropriate references.
2. Notify the Owner a minimum of one week prior to intended testing period.
 - a. Schedule testing to be performed between 8:00 AM and 3:30 PM and to begin on a Monday or Tuesday.
 - b. If more than one day of testing is required, schedule testing to be done on consecutive days.
3. Provide support facilities which includes but is not necessarily limited to electrical power, water, air, equipment chemical storage tanks, mixing equipment, sampling equipment, testing chemicals and equipment and incidental items.

C. Basic Common Elements of Performance Tests:

1. Water used for performance tests shall be tap water.
 - a. Ensure water temperature is between 15 - 25 DEGC.
2. Chemical additive #1:
 - a. In each test, a 10% (by weight) solution of sodium sulfite Na_2SO_3 shall be prepared in sufficient quantity to deplete the dissolved oxygen concentration in tank to zero and maintain zero reading condition for a minimum of one minute.
 - b. Stoichiometrically, approximately 75 pounds of 96% pure sodium sulfite are required per million gallons of tank volume to deplete the dissolved oxygen concentration 1 milligram per liter.
 - c. Use only technical grade sodium sulfite, free of catalyst.
 - d. Approximately 150% of stoichiometric quantity will be required to achieve and maintain zero conditions for one minute.
3. Chemical additive #2:
 - a. A 10-percent (by weight) solution of cobalt chloride $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ shall be prepared for the initial series of tests.
 - b. Approximately 34 pounds of cobalt chloride are required per million gallons of tank volume to produce 1 milligram per liter.
 - c. For test purposes, use cobalt ion concentration of 0.5 mg/L.
4. Test setup:
 - a. For initial series, introduce cobalt chloride solution to desired residual.
 - b. After cobalt ion residual is obtained, mix or agitate tank volume for a minimum of 15 minutes.
 - c. Add sodium sulfite solution to tank within a period of five minutes start to finish.
 - 1) Add solution of multiple points to achieve uniform dispersion throughout tank.
 - d. After first series of tests are complete, prepare another batch of sodium sulfite.
 - 1) No additional cobalt chloride shall be added after first series of tests.
 - e. Perform additional series of tests according to same procedure; however, no more than 10 series of tests shall be made in same test water.
 - f. Ensure disposal of waste materials, water, chemicals, and incidentals after testing in acceptable manner to appropriate regulatory agencies.
5. Oxygen transfer coefficient (KL(a))T:
 - a. For each point of measurement specified, compute overall oxygen transfer coefficient by determining slope of line of best fit by following equation:

$$\frac{\ln((C_s - C_1)/(C_s - C_2))}{(KL_a)T} = t_2 - t_1$$

Where: \ln - natural logarithm to base(e)

T = water temperature, DEGC

$C_s - C_1$ = Initial t_1 dissolved oxygen deficit, mg/L

$C_s - C_2$ = final t_2 dissolved oxygen deficit, mg/L

$t_2 - t_1$ = time span from initial to final reading, hours

C_s = oxygen saturation at test site barometric pressure and liquid temperature T; the theoretical oxygen saturation value at a point 1/3 depth from water surface to point of air application.

- b. Calculate and plot on semi-log graph paper the dissolved oxygen deficit from saturation ($C_s - C_i$) for each measurement.
 - 1) Plot with log axis as ordinate with dissolved oxygen deficit and linear axis as abscissa with time (t).
 - 2) C_i is the measure oxygen concentration at any time (t).
 - 3) By regression analysis, draw a line of best fit on all points between 20 and 80% of saturation value C_s .
- c. Correct oxygen transfer coefficient $(KL_a)T$ for each measurement point to 20 degrees C by the following equation:

$(20 - T)$

$$X = (KL_a)20C = (KL_a)T \times 1.024$$

The values of X for each condition specified shall be average and at least two-thirds of individual X values shall be within 10% of average value.

If not, conduct additional series of test until two-thirds of X values are within 10% of the average of all X values.

- d. The average value of X, $(KL_a)20C$ Oxygen transfer coefficient shall be equal to or greater than specified under appropriate "Performance Requirements."

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 46 51 33
FLEXIBLE MEMBRANE DISC DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Removal and disposal of existing 9-inch ceramic disc elements and existing orifice plugs.
 2. Requirements for replacement of existing diffuser elements, installation of new diffuser assemblies into existing “blank” diffuser holders, and modification of existing diffuser grids to accommodate new equipment installation.
 - a. For replacing existing ceramic elements with new elements, new membrane elements and O-rings will be required.
 - b. For replacing existing blank diffusers with new elements, new membrane elements, O-rings, and retainer rings will be required.
 - c. For replacing existing ceramic elements with blanks, new orifice plugs will be required.
- B. As shown on the Drawings, the aeration basins are arranged in 2 process trains.
1. Each process train begins with one anoxic zone.
 2. Process train basin flow sequences are as follows:
 - a. Zone 1: Anoxic.
 - b. Zone 2: Aerobic.
 - c. Zone 3: Aerobic.
- C. Related Specification Sections include but are not necessarily limited to:
1. Section 01 61 03 - Equipment - Basic Requirements.
 2. Section 05 50 00 - Metal Fabrications.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Society of Civil Engineers (ASCE):
 - a. 18-96, Standard Guidelines for In-Process Oxygen Transfer Testing.
 2. American Society of Civil Engineers/Environmental and Water Resources Institute (ASCE/EWRI):
 - a. 2-06, Measurement of Oxygen Transfer in Clean Water.
 3. American Society for Testing and Materials (ASTM):
 - a. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - b. A380, Standard Practice of Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - c. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - d. D573, Standard Test Method for Rubber-Deterioration in an Air Oven.
 - e. D1171, Standard Test Method for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).
 - f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - g. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- B. Qualifications:
1. All equipment shall be supplied by a single Manufacturer or Supplier.
 2. Manufacturer of fine bubble membrane disc diffusers shall have a minimum of 10 installations in operation for more than three years.
 3. Supplier to provide with first submittal a list of 10 membrane disk installations that have operated for a minimum of three years continuously.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 2. Fabrication and/or layout drawings.
 - a. Diffusers:
 - 1) Manufacturer.
 - 2) Type and model.
 - 3) Dimensional information.
 - 4) Stable airflow rate range and corresponding head loss.
 - 5) Oxygen transfer efficiency (clear water) for design conditions.
 - 6) Mounting arrangement.
 - 7) Mounting instructions.
 - 8) Number and distribution per basin.
 - 9) Acceptable air flow range per diffuser.
 - 10) Engineering calculations.
 - a) Documenting number of diffusers.
 - b) Document SOTR achieved.
 - c) Document mixing achieved.
 - d) Document uniform: Distribution of air throughout each drop leg basin grid so that the air flow per diffuser does not vary by more than 5% at any specified air flow rate.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. Performance test data (results and reports):
 - a. Including but not limited to:
 - 1) Certified oxygen transfer tests.
 - 2) Quality control tests.
 - 3) Permeability tests.
 - 4) Uniformity test.
 - 5) Strength testing.
 - 6) Chemical resistance data.
 - b. Reports signed by registered professional engineer.
 - c. Reports to include:
 - 1) Description of test facility.
 - 2) Description of sampling procedures.
 - 3) Engineering calculations.
 - 4) Summary of test results.
 - 2. Warranty.
 - 3. Certificate of Proper Installation:
 - a. Include benchmark pressure at the connection drop leg to the airflow control butterfly valve.
 - b. Determine benchmark pressure as specified in the FIELD TESTING Article in PART 3 of this Specification Section.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect the diffusers when exposed to the elements before being placed into operation per manufacturer's recommendations.

1.5 WARRANTY

- A. All aeration equipment components and accessories to be free of defects in materials, workmanship, and installation for a period of one year from date of Final Acceptance in writing and signed jointly by Manufacturer and Contractor.
- B. In addition, the Manufacturer shall warrant the following:
 - 1. The membrane diffuser elements shall not fail for a period of seven years after delivery or six and one-half years from Substantial Completion, whichever occurs first.
 - a. Failure is defined as one or more of the following measured or observed changes on diffusers in a cleaned condition:
 - 1) Any rupture or tear of the membrane.
 - 2) Any measured durometer exceeding 80 Shore A.
 - 3) If one or both of the above changes occurs, the manufacturer shall provide replacement membranes for the failed membranes to the Owner for replacement by the Owner.
 - a) If more than 60% of the membranes in a tank fail, all membranes in the tank shall be provided with replacement membranes.
 - 2. Additionally, the manufacturer shall warranty the aeration system and components as follows:
 - a. Manufacturer shall warrant that membranes will operate continuously for seven years after start-up, and pressure drop increase across membranes in a cleaned condition as compared to benchmark pressure drop test specified in the FIELD TESTING Article in PART 3 of this Specification Section shall not exceed 0.7 psiG during that period.
 - b. If the pressure drop increase exceeds 0.7 psiG, as determined by Owner, pressure drop testing on clean membranes within seven years after start-up, the manufacturer shall furnish new membranes for all diffusers within the affected tank(s) to the Owner for replacement by the Owner.
 - c. Manufacturer will be compensated for providing replacement membranes according to the following formula:

$$\text{Replacement Membrane Compensation} = \frac{(P)(Y)(N)}{7}$$

P = Purchase price per new membrane delivered to site
Y = Years of operation prior to failing pressure drop test by Owner
(Partial years will be rounded to nearest 0.1 year)
N = Total No. of Replacement Membranes

1.6 EXTRA MATERIALS

- A. Furnish, tag and box for shipment and storage the following spare parts:
 - 1. Diffusers:
 - a. 10% extra diffusers, including gaskets.
 - b. 10% extra diffuser assemblies.
 - c. 10% extra diffuser tap plugs.
 - 2. One set of special tools required to assemble/disassemble the diffusers and grid piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Xylem Sanitaire Silver Series.
 - 2. Pentair FlexAir.
 - 3. Aquarius (Aerzen) Quantaer.
 - 4. Stamford Scientific, Inc. (SSI Aeration).

2.2 MATERIALS

A. Membrane Diffusers:

1. Circular membrane diffuser discs of 9 inches diameter with integral O-ring of EPDM synthetic rubber compound with precision die formed slits.
 - a. Thermoplastic materials (i.e., plasticized PVC or polyurethane) are not acceptable.
2. Add carbon black to the material for resistance to ultraviolet light.
3. Design diffuser as one-piece injection molded part with a minimum thickness of 0.080 inches.
4. Limit the maximum tensile strength of the diffuser to 10 psi when operating at 2.4 SCFM/FT² of material.
 - a. Furnish proportionately thicker material for larger diameter disc diffusers to limit the maximum tensile stress and to resist stretching.
5. Produce diffusers free of tears, voids, bubbles, creases or other structural defects.
6. Furnish diffuser material to meet the following:
 - a. Base polymer: EPDM, ASTM D573.
 - b. UV resistance: Carbon black.
 - c. Specific gravity: 1.25 or less.
 - d. Durometer: Minimum 40 durometer, +5%, ASTM D2240.
 - e. Modulus of elasticity: 425 psi, ASTM D412.
 - f. Ozone resistance (72 hours: 104 degrees F, 50 PPHM): No cracks at 2X magnification, ASTM D1171, Test A.
 - g. Tensile strength: 1200 psi, ASTM D412.
 - h. Elongation percentage:
 - 1) Retained 70 hours at 212 degrees F: 75% maximum, ASTM D573.
 - 2) Minimum at break: 350%, ASTM D412.

B. Diffuser Assemblies:

1. Furnish diffuser assemblies including diffuser, diffuser gasket, holder, retaining ring and air flow control orifice if existing assemblies and holders require replacement.
2. Membrane diffuser:
 - a. Incorporate an integral check valve into the membrane diffuser.
 - b. Design and test diffusers for a dynamic wet pressure (DWP) of 6 inches ±20% water column at 1.0 SCFM/diffuser and 2 inches submergence.
3. Diffuser support plate: Provide a PVC or glass filled polypropylene support plate to form an air plenum under the diffuser and support for the membrane when the air is off.
4. Diffuser assembly to be fusion welded to air distribution piping.
 - a. Mechanical attachment of diffuser assembly to air distribution piping is not allowed.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Design Criteria:

1. Provide aeration in aeration basins as shown on the Drawings and complying with the following:
 - a. Side water depth: 12 feet.
 - b. Minimum diffuser submergence: 10.9 feet.

B. Existing ceramic disc diffuser installation for each of the aeration basins as shown in the table below:

AB ZONES	ELEMENTS INSTALLED	BLANKS REMAIN	LENGTH (FT)	WIDTH (FT)	VOLUME (MG)
AB3 Z1	410	164	46	39.25	0.162
AB3 Z2	290	127	46	39.25	0.162
AB3 Z3	160	160	46	39.25	0.162

AB ZONES	ELEMENTS INSTALLED	BLANKS REMAIN	LENGTH (FT)	WIDTH (FT)	VOLUME (MG)
AB4 Z1	410	164	46	39.25	0.162
AB4 Z2	290	127	46	39.25	0.162
AB4 Z3	160	160	46	39.25	0.162

C. Provide aeration grids for each of the aeration basins as shown in the table below:

AB ZONES	ELEMENTS INSTALLED	BLANKS REMAIN	DISCS REMOVED	LENGTH (FT)	WIDTH (FT)	VOLUME (MG)
AB3 Z1	410	164	0	46	39.25	0.162
AB3 Z2	417	0	0	46	39.25	0.162
AB3 Z3	299	12	9	46	39.25	0.162
AB4 Z1	410	164	0	46	39.25	0.162
AB4 Z2	417	0	0	46	39.25	0.162
AB4 Z3	299	12	9	46	39.25	0.162

D. Diffusers:

1. Membrane disc.
2. Diameter: 9 inches.
3. Install sufficient diffusers to meet the minimum oxygen demand at the low flow condition, while maintaining 1.5 SCFM per diffuser or less.

E. Maximum Airflow (SCFM) Distribution Summary:

Flow/Loading Condition	Aeration Grid Equipment Number					
	AB3 Z1	AB3 Z2	ZB3 Z3	AB4 Z1	AB4 Z2	AB4 Z3
Annual Average	0	655	300	0	655	300
Peak Month	0	960	440	0	960	440
Peak Day Day	0	1,150	530	0	1,150	530
Peak Hour	0	1,380	635	0	1,380	635

F. Maximum pressure at top of drop leg all basins: 6.15 PSIG.

G. Mixing Requirements:

1. Ensure mixing over the air flow range specified prevents deposition of solids in or near basin corners behind columns, supports and incidental structural components.
2. Ensure no progressive buildup of solids exists or is such that process can be adversely affected.

H. Holders Installed:

1. Number to meet maximum air flow rates, head loss and oxygen demand requirements above plus additional 20%.

I. Air Distribution System:

1. Header pipe diameter in aeration basin: As shown on Drawings.

2. Drop leg pipe diameter:

Zone	Grid Tag No.	Diameter (IN)
Aeration Basin 3 Zone 1	AB3 Z1	8
Aeration Basin 3 Zone 2	AB3 Z2	6
Aeration Basin 3 Zone 3	AB3 Z3	6
Aeration Basin 4 Zone 1	AB4 Z1	8
Aeration Basin 4 Zone 2	AB4 Z2	6
Aeration Basin 4 Zone 3	AB4 Z3	6

3. Air distribution manifold diameter: As shown on Drawings.

PART 3 - EXECUTION

3.1 AERATION BASIN CLEANING

- A. Aeration Basin 04 is anticipated to have accumulated approximately 1.75 feet (approximately 350 cubic yards) of grit that will need to be removed by the Contractor.
 - 1. Removal of grit shall not impact existing diffuser grids.
 - 2. Aeration Basin 03 should have minimal grit to be removed.
 - 3. Grit and other solids removed from aeration basins must be disposed of in a landfill.
 - a. Solids must pass paint filter liquids test using Test Method 9095B prior to disposal.

3.2 INSTALLATION

- A. See Specification Section 01 61 03.
- B. Install in compliance with manufacturer's instructions:
 - 1. Do not use power tools to secure orifice bolts, clamps, or retaining rings.
 - 2. Use calibrated torque wrenches that slip when set torque is exceeded.
- C. Diffuser Leveling:
 - 1. Installed within $\pm 1/4$ inches of common horizontal plane.
 - 2. Check installation elevation by filling basin to top of diffusers.
 - 3. Adjust diffuser elevations as required to achieve horizontal plane.
- D. Cleaning:
 - 1. Clean all piping to remove visible dirt, dust, and other matter before starting system or installing diffusers.
 - 2. Do not use process air compressors for air cleaning.
 - 3. Air furnished by Contractor.

3.3 FIELD QUALITY CONTROL

- A. Provide manufacturer's field services in accordance with Specification Section 01 75 00.
 - 1. Provide Owner with a written Certificate of Proper Installation that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.
 - 2. Include results of benchmark pressure test.

3.4 TRAINING

- A. Provide on-site training in accordance with Specification Section 01 75 00 as specified below:
 - 1. One, 4 hour training session.

3.5 FIELD TESTING

- A. Contractor is to pay for all testing and remedial action.

- B. Quality Control Tests:
1. Perform the quality control tests described below by the equipment supplier.
 - a. Submit detailed reports on all test results to the Engineer for acceptance prior to shipment.
 2. Unless otherwise specified, perform each test on a minimum total sample size of 40 diffusers selected at random from the total number of diffusers to be supplied.
 - a. If diffuser production requires multiple batches, select, at random, an equal number of diffusers from each batch so that the total number of diffusers tested is not less than 40.
 3. For each quality control test, 95% of the diffusers tested shall comply with the requirements of the test.
 - a. If more than 5% of the test sample fails to meet the requirements of the specific test, then the entire batch of diffusers shall be tested to ensure that 95% of all diffusers meet the test requirements.
- C. Uniformity Testing:
1. Perform a uniformity test to demonstrate an even distribution of air bubbles when the diffusers are submerged.
 - a. For the number of diffusers selected for the test, submerge the diffusers to a depth of 1 IN of clean tap water.
 - b. Apply an initial air flow of 2.5 SCFM per diffuser for a period of five minutes and then reduce the air flow per diffuser in increments of 0.5 SCFM for a period of five minutes at each air flow rate to a minimum of 0.5 SCFM per diffuser.
 - c. Visually observe and photograph the water surface to assure uniformity of air distribution.
 2. Conduct the uniformity test with diffusers arranged and spaced in a pattern similar to that proposed for the installation.
 - a. 95% of the diffusers tested shall show a substantially even distribution of air at air flows from 0.5 to 2.0 SCFM per diffuser.
- D. Benchmark Pressure Test.
1. Perform following benchmark pressure test for each basin.
 - a. Temporarily provide and install calibrated 0-15 psi pressure reading device with 0.05 PSI graduations located at connection of air line to butterfly valve.
 - b. Adjust airflow to basin drop leg to equal 2.5 SCFM per installed diffuser as measured by flowmeter installed at drop leg.
 - c. Measure and record:
 - 1) Drop leg pressure in psig.
 - 2) Airflow in SCFM using flowmeter port installed in air line.
 - 3) Ambient air temperature.
 - 4) Relative humidity.
 - 5) Barometric pressure.
 - 6) Basin liquid elevation.
 2. Submit test results attesting in writing that values provided represent aeration system benchmark pressures.
 - a. Benchmark pressures will be compared with subsequent like testing results by the Owner, at its discretion, with diffusers in a cleaned condition to determine compliance with warranty requirements.
- E. Shop Oxygen Transfer Test:
1. Conduct a performance test to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.
 - a. The test will be witnessed by a representative of the Owner.
 2. Base all tests on the following criteria:
 - a. A minimum of three tests for the average and peak conditions in complete accordance with ASCE/EWRI 2-06 normalized to 1000 mg/l TDS for each aerobic zone.

- b. Conduct tests by an aeration testing firm in a full scale aeration test tank (minimum of 200 square feet) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration.
 - 1) Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.
 - c. Conduct shop test with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.
 - d. Plot of standard condition pounds of oxygen transferred per day per 1000 cubic feet of tank volume versus standard condition cubic feet of air per minute per 1000 cubic feet of tank volume: (LBS-O₂/day/1000 cubic feet-tank) vs. (SCFM/1000 cubic feet-tank).
 - 1) Standard conditions of oxygen transfer are defined as 68 degrees F, 1 atmosphere ambient pressure, clean water.
 - 2) Standard air is defined as 68 degrees F, 1 atmosphere, 36% R.H., containing 23 percent oxygen by weight.
 - 3. Certify and stamp all tests by a Professional Engineer.
 - 4. Include all costs for testing (exclusive of witnesses' expenses) in the equipment price.
 - a. All tests may be witnessed at Owner/Engineer option.
 - b. Cost of travel and living expenses for Owner/Engineer to be paid by the Owner.
 - 5. Submit all test data from oxygen transfer tests for approval by the Engineer prior to manufacturing equipment.
- F. Off-gas Testing:
- 1. Standard off-gas testing:
 - a. Conduct clean water test on first basin converted to diffused air system.
 - b. Conduct off-gas test on same basin after at least one month of continuous operation.
 - 1) Coordinate date with the Owner.
 - 2. According to ASCE 18-96.
 - 3. The following basin coverage will be followed:
 - a. Test at least two of the three trains.
 - b. Hoods will cover at least 4% of the test basin.
 - c. Use a minimum of six hood positions per train.
 - 4. Administered by:
 - a. An approved independent tester.

END OF SECTION